

Mayor's Greenprint Denver Advisory Council

OCTOBER 2007

CITY OF DENVER CLIMATE ACTION PLAN

FINAL RECOMMENDATIONS TO MAYOR HICKENLOOPER



DENVER
THE MILE HIGH CITY





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The Greenprint Advisory Council's final recommendations are provided as an electronic document only, in order to save additional resources.

October 2007

Dear Mayor Hickenlooper:

On behalf of the Greenprint Denver Advisory Council, we would like to report back to you on the Council's efforts in soliciting and considering public feedback on the draft Climate Action Plan released in May of this year. In addition, we wish to finalize our recommendations to you and urge their enactment within the City and County of Denver.

Over the past four months, we hosted several public forums and participated in other events at which over 300 people were present. In addition, comments on the Climate Action Plan were solicited via a weblog, as well as through regular e-mail and written correspondence. We reviewed the comments received from these and other sources, and have developed a final version of the Climate Action Plan, for your consideration.

We see great opportunities in the months ahead, especially with the Democratic National Convention next year, to bring about the quick implementation of many of these recommendations. We offer our support and continued willingness to work with you, either on an individual basis or as a full Council, to see to it that this Plan becomes a reality.

Although we label these as "Final" recommendations, we do not believe that our work, nor the efforts of the City to reduce greenhouse gas emissions, should be considered completed even with the full implementation of this plan. As the scientific consensus on climate change becomes more evident and as the technologies and programs to increase energy efficiency and reduce greenhouse gas emissions continue to improve, additional actions will need to be considered. However, we view these recommendations as a worthy first step along the path to a truly sustainable city.

For the entire Greenprint Denver Advisory Council,



Benita Duran
Co-chair



Daniel Yohannes
Co-chair

Letter from Greenprint Denver Advisory Council accompanying the original draft Climate Action Plan

May 2007

Dear Mayor Hickenlooper:

Since its inception, Denver has distinguished itself by its willingness to embrace a progressive civic agenda. Today, we are faced with a global set of energy and climate-based challenges — challenges whose solutions will depend on localized leadership and actions. Greenprint Denver represents the City's acknowledgement of its responsibility within this global effort, and sets forth an aggressive set of goals and a realistic action plan for achieving these goals.

A year ago you invited our group of three dozen business, civic, and community leaders to advise you on the ongoing development of the City's Greenprint Denver action agenda. In this short time, the sense of broader possibilities and forward momentum for sustainable practices within the City have grown significantly. The City has laid a strong foundation and led by example within the community. In September of 2006, our Council agreed to spend several months studying ways to engage the entire community: residents, neighborhood and community groups, business and industry, and youth — in considering what steps can be taken by the City and its citizens to address the threat posed by global warming. As you have said, even if there's a three percent chance that 95 percent of the climate scientists are correct in their assessment of future climate trends, the implications for Denver and the region are significant — and doing nothing is a risk we cannot afford to take with our future. We agree with your assessment and believe that major actions are required to reduce our carbon emissions to the levels that are called for under the US Mayors Climate Protection Agreement.

Our diverse membership has conducted its deliberations in a collaborative manner and minimized our collective carbon footprint with our own sustainable group practices. Our recommendations reflect a common and abiding faith in our community's ability to rise to meet the significant challenges. Rarely have contemporary political, scientific, and economic dynamics been more conducive to decisive action.

With excellent support from City staff and experts from the University of Colorado at Denver, we have studied the problem of global warming and the possible remedies available at the local level, listened to a variety of experts with concerns and interests in this matter, and have formulated the recommendations contained in this report for your further consideration. These recommendations are but a subset of the thousands of ideas and policies available. While our evaluation criteria involved technical, economic, and political considerations, this report represents a consensus belief that Denver's approach to climate change must be effective, measurable, and capable of attracting the widest possible public support.

Many of our recommendations are challenging and will require serious commitments on the part of both the leadership as well as the residents of our community. This is a draft for public input and our next steps involve soliciting feedback for your consideration.

On behalf of the entire Greenprint Denver Advisory Council,



Benita Duran
Co-chair



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Executive Summary

Global climate change will very likely be the defining issue of the 21st Century. At its dawn, we face the knowledge that industrialization, and its historic reliance on the combustion of fossil fuels like coal, natural gas, and oil, has significantly increased the amount of carbon dioxide and other greenhouse gases in our atmosphere. We also are beginning to understand some of the implications of these greenhouse gas emissions for our planet: namely, warmer days and nights; more intense storms; more severe droughts; melting glaciers; and rising oceans. The impacts of these physical changes on the Earth's inhabitants are less well understood; however, scientists, politicians, and business leaders around the world have sounded the alarm with an ever-increasing sense of urgency, identifying a range of concerns, including compromised freshwater supplies; reduced agricultural production; significant risks to coastal communities and major population centers from rising sea levels and stronger hurricanes; and the increased likelihood of extinction for many species.

Here in Colorado we face the danger of reduced annual snow packs, affecting both water supply and tourism, and secondary impacts of warming, such as pine beetle infestations and changing agricultural economics.

Under the leadership of Mayor John Hickenlooper, Denver is poised to join the ranks of the world's leading cities in taking decisive steps to reduce local contributions to the greenhouse gas problem — and at the same time, to position Denver as a leader in establishing a diversified economy based on the combined use of traditional and alternative sources of energy. Although there will be up-front costs associated with some of these mitigation efforts, they will ultimately save many energy dollars and, more important, will pale in comparison to the likely costs of inaction resulting from global warming and its related impacts.

In 2005, Mayor Hickenlooper established Denver's initial greenhouse gas reduction goal: by 2012 Denver will reduce its emissions of greenhouse gases by 10 percent per capita relative to 1990 levels. Since that time, Mayor Hickenlooper's Greenprint Council — an advisory group of civic and business leaders, joined by managers of several City departments — has worked with scientists and policy makers to understand the issues and opportunities faced by the City as it grapples with this challenge.

Denver's Carbon Footprint

A greenhouse gas inventory of Denver reveals that the sources of our greenhouse gas emissions come from three main sectors: 1) Transportation, 2) Residential-Commercial-Industrial Energy Use, and 3) Use of Key Urban Materials. The greenhouse gases produced from these activities are related in large part to the source of power generation — in the case of transportation, petroleum, and in the case of buildings and commercial/industrial activities, electricity generated from coal- and natural gas-powered plants along with natural gas used for the heating of buildings. Key materials (such as concrete, water, and food) require energy of various types to manufacture items without which city life would not be possible.

Denver has a rich history as a center of energy development. In our challenge to reduce emissions and their related environmental, health, and economic costs, we have an opportunity to lead the country—indeed, the world—in developing new technologies to improve traditional energy sources, improve energy efficiency, and create new energy sources.

Denver's Goals

The Denver region has experienced significant population growth over the past decade, and emissions have increased in almost direct proportion to that growth, although the **per capita greenhouse gas emissions have remained nearly constant at about 25 metric tons of carbon dioxide equivalents (mtCO₂e) per person per year from 1990 to 2005.*** Our original goal of a 10 percent per capita reduction in greenhouse gases from 1990 levels by the year 2012 appears to be attainable, and corresponds to reducing Denver's annual total community-wide greenhouse gas emissions by 1.8 million metric tons of CO₂ equivalents from the business-as-usual projections. However, reaching this goal also means that absolute, or total, emissions will have increased significantly since 1990 due to population growth (see Figure ES-1). Indeed, based on population projections, **a 10 percent per capita reduction by 2012 will still result in a 16 percent increase in Denver's total contribution of greenhouse gases to our global atmosphere over 1990 levels**, with annual emissions of 13.7 million metric tons in 2012 compared with 11.8 million metric tons in 1990. To begin to stabilize and then reduce our greenhouse gas emissions, we must commit to more ambitious goals over the long term. Based on an understanding of what is at stake for the City and the region in the context of global warming, and the time-sensitivity of reducing our emissions, **we recommend that the City adopt an absolute reduction target of 25 percent — to get the entire Denver community below 1990 levels — by 2020.** This corresponds to mitigating 4.4 million metric tons of CO₂ equivalents annually by 2020 from the business-as-usual projections.

**The average individual uses ~15 mtCO₂e per year.*

How much is a “metric ton of CO₂ e”?

One ton of carbon dioxide gas would fill a 30-foot diameter balloon. In one year, the average individual in the U.S. produces enough CO₂ to fill about 15 of these balloons, enough to stretch from goal line to goal line of a football field one and one-half times! Another way to imagine the carbon in the greenhouse gas emissions of the average individual is to imagine producing an 8-foot-square block of coal for every man, woman, and child in the city.

The Mayor's Greenprint Council recommends that in addition to the 2012 goal, Denver adopt a Year 2020 goal as described below.

2012 Goal: Reduce Denver's **per capita** greenhouse gas emissions by 10 percent below 1990 levels, thereby reducing community-wide emissions by 1.8 million metric tons of CO₂e annually, by 2012. This is equivalent to eliminating a small [250 megawatt (MW)] coal-fired power plant, or taking about 260,000 cars off the road.

2020 Goal: Decrease **total** community-wide emissions to below 1990 levels, which equals a community-wide reduction of 4.4 million metric tons of CO₂e annually. This is equivalent to eliminating 2 small coal-fired power plants [550 MW], or taking about 600,000 cars off the road.

Note: Throughout this report, when discussing “coal-fired power plants,” we are referring to conventional plants using pulverized coal as the fuel source.

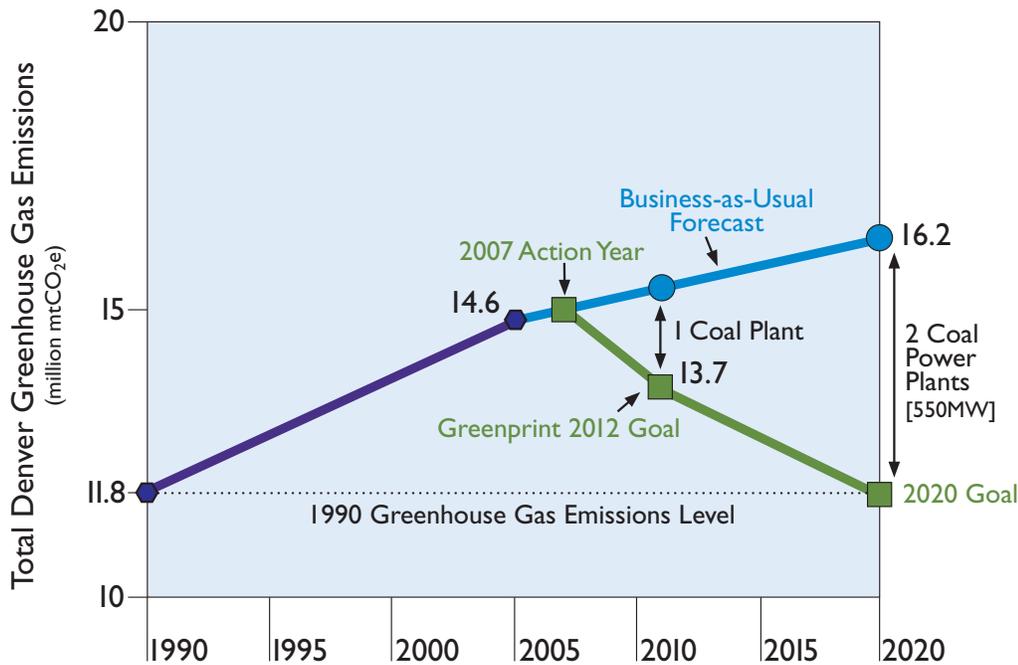


Figure ES-1

Denver's community-wide greenhouse gas projections with and without recommended actions.

Emissions are shown in million metric tons of CO₂ equivalents (CO₂e). (The business-as-usual scenario incorporates population growth with assumed steady per capita emissions of 25 mtCO₂e plus small increasing trends seen in buildings' electricity use. The 2012 goal will eliminate 1.8 million mtCO₂e annually, equivalent to eliminating the need for 1 coal-fired power plant. The 2020 goal will mitigate 4.4 million mtCO₂e annually, equivalent to removing 2 coal-fired power plants.)

If we can begin to reduce our electricity consumption and make our transportation system more efficient, we can avoid building new coal-fired power plants and reduce our crude oil consumption, thus preventing a significant increase in our greenhouse gas emissions, along with other air pollutants.

Recommended Climate Action Strategies

After more than seven months of study, the Greenprint Council has developed a series of recommendations designed to help Denver meet its short-term climate goals. These recommendations are in the form of specific actions that can be taken by individuals, businesses, and the City and County of Denver, in service of a larger, overarching objective: **to avoid the construction of new coal-fired power plants intended to serve Denver's growing population and energy demands.**

These priority strategies have been evaluated in terms of cost-effectiveness, impact, and their potential to engage the public, and they are distributed across the sectors most responsible for greenhouse gas emissions. Detailed summaries of each are found in Section 3 of this report.

If adopted, the following ten recommendations are projected to achieve our 2012 goal, resulting in total annual emissions reductions of 1.8 million metric tons of CO₂ equivalents.*

1. Corporate and Residential Climate Challenges (28 percent toward 2012 goal) — Develop major business and residential outreach campaigns supporting the adoption of best practices related to energy conservation, purchase of renewable energy, support for multi-modal transportation, and waste reduction in the commercial and residential sectors.

2. Incentivize Energy Conservation (25 – 40 percent toward 2012 goal) — Introduce a proposal to apply a tiered rate structure to electrical and natural gas usage. Similar to water use rate charges, such electrical and natural gas tiered rates would impose a premium charge for excessive electrical and natural gas usage. Voter approval should be sought for this measure. Funds generated would be used to support energy conservation and greenhouse gas reduction programs, especially for lower-income neighborhoods.

** Note: the ten recommendations are expected to contribute to greenhouse gas mitigation if all other factors remain the same. For example, if the use of air conditioners increases significantly beyond current trends, the energy savings from the actions listed below may be substantially offset by such increases in electricity use.*

3. Voluntary Travel Offset Program (20 percent toward 2012 goal) — Provide the opportunity to pay a small voluntary fee, at the time of air travel or motor vehicle registration, to offset the carbon emissions related to travel. Funds would be used for carbon-absorbing or carbon-reducing activities. Explore potential partnership with the Governor's Energy Office to develop local offset investment opportunities.

4. City Leading by Example (9 percent toward 2012 goal) — In addition to the 5-year goals for City practice improvements outlined in the 2006 Greenprint Denver Action Agenda, aggressively pursue opportunities for energy efficiency and renewable energy at Denver International Airport, work to develop “carbon neutral” City buildings through application of energy efficiency savings to the purchase of Windsource, and make additional City fleet improvements.

5. Enhance Recycling Programs (2 percent toward 2012 goal) — Support new and expanded recycling initiatives throughout Denver, including multi-family, commercial, and green waste recycling, as part of the development of a comprehensive Solid Waste Master Plan. The goal is to double the present recycling rate, which contributes to both energy and greenhouse gas savings.

6. Energy Efficiency Standards for New Buildings and Remodels (4 percent toward 2012 goal; long-term {2020} impact up to 12 percent) — Adopt a set of mandatory building standards for commercial buildings and building codes for new homes and some remodels that incorporate energy efficiency standards and renewable energy requirements.

7. Increase Energy Efficiency in Existing Homes (1–4 percent toward 2012 goal; more than 10 percent toward long-term {2020} goal) — Promote basic energy efficiency measures at residential properties as a way to improve the energy efficiency of older housing stock. Incentives to plant shade trees and install in-home energy display systems would enhance the effectiveness of this program.

8. Community-wide High-performing Green Concrete Policy (3 percent toward 2012 goal) — Require, through City policies, the use of “green” concrete, containing a low to moderate percentage of fly ash, in all public and private construction projects. Pilot projects are recommended using both fly ash and recycled aggregates, in public and private projects to evaluate the feasibility of large-scale implementation.

9. Compact Growth Boundary with Incentives for Density in Urban Areas (2 percent towards 2012 goal; greater than 10 percent by 2020) — Support maintenance of the existing DRCOG growth boundary and support additional population growth around transit in the metro area to promote denser, more pedestrian-, bicycle-, and transit-friendly neighborhoods that will reduce the demand for motorized personal transport.

10. City Support for Alternative Transportation Strategies (~2 percent toward 2012 goal) — Develop various City policies that promote the transition over time to the use of alternative transportation sources (such as bicycles, telecommuting, walking, van/car pools, and mass transit). These strategies may also include the promotion of alternatively fueled and high-fuel economy vehicles, including parking subsidies, car-share programs, and access fee discounts for hybrid taxis at DIA.

Taken together, these City-based actions described above are projected to result in the mitigation of 1.8 million metric tons of climate-changing greenhouse gases annually by 2012, decreasing Denver's per capita greenhouse gas footprint by more than 10 percent relative to 1990 levels.

By employing all of these measures, along with the will of the citizens of Denver, we can reach our goal: **to eliminate the need for the equivalent of one coal-fired power plant by 2012 and set us on a course toward eliminating a second one by 2020.**



Section I: Introduction

In July of 2006, Denver Mayor John Hickenlooper launched Greenprint Denver, an ambitious sustainability program, at his 3rd annual State of the City address. The Action Agenda he unveiled focused primarily on integrating sustainability as a key principle within City government operations, and further adopted a set of ambitious goals to help the City lead by example over the coming five years. A City and community advisory group, the Mayor's Greenprint Council, was formed prior to his announcement, to support and guide the effort.

Following the release of the Action Agenda, the Mayor's Office received calls and inquiries from citizens and businesses wanting to know how they could support the goals and values represented by Greenprint Denver. In September of 2006, the Mayor's Greenprint Council, working closely with City staff and faculty and students from the University of Colorado at Denver's Urban Sustainable Infrastructure Engineering Project, embarked on an ambitious 7-month planning process to consider how to engage the broader community in Greenprint Denver generally, and specifically how to accomplish the City's commitment under the US Mayors Climate Protection Agreement: **to reduce citywide per capita emissions by 10 percent relative to 1990 levels by 2012.**

Denver's Climate Action Plan follows in the footsteps of cities such as London (UK), Portland (OR), San Francisco (CA), and Seattle (WA), all of which — through aggressive greenhouse gas reduction programs and policies — have seen real greenhouse gas reduction and have also realized significant economic benefits from their greening efforts. This Climate Action Plan should be viewed not only as a greenhouse gas reduction plan, but also as a jobs plan, a children's and community health plan, an energy security plan, as well as a plan for improving Denver's overall quality of life. Greenprint Denver is also providing a model and template for many other cities throughout the state and nation. Mayor Hickenlooper's leadership on this issue is made possible by support from regional mayors, the Denver business community, and Denver's civic and neighborhood groups. Positioning Denver as a sustainability leader nationally will reap both economic and environmental benefits for the future of the City.



Our recommendations will help Denver to . . .

- . . . reduce our energy consumption without sacrificing our quality of life.
- . . . promote new and "clean" businesses that provide high-quality jobs.
- . . . improve our health and well-being.
- . . . eliminate the need for one coal-fired power plant (equivalent to taking 260,000 cars off the road).
- . . . reduce emissions equivalent to over half a million cars off our roads by 2020.

In this report, we address the relevance of global climate change issues to the Denver community, describe the Greenprint Council's planning process, provide an overview of the greenhouse gas inventory developed for the City by scientists at the University of Colorado at Denver, and lay out our priority recommendations to the Mayor for the City to achieve its greenhouse gas reduction goals.

The recommendations in this report focus on reducing or mitigating greenhouse gas emissions. Many scientific projections now assert that, even with an aggressive and successful greenhouse gas reduction program, climates on Earth will be affected by the increase in greenhouse gases that has already occurred. Thus, Denver must also consider approaches to adaptation and mitigation, in order to lessen the adverse impacts of climate change in our region.

Adaptive responses (that is, measures taken that respond to the local effects resulting from global warming) are an important complement to climate action plans. As such, the Greenprint Council commends the Mayor's Million Trees Campaign ("Tree by Tree — The Mile High Million") as an important step in alleviating some of the impacts of global warming. Using trees to shade the City during the heat of the summer and to create cooler micro-climates within the urban environment will help to reduce energy demand and will make Denver a more comfortable place to live. Although beyond the scope of this report, the Greenprint Council recommends that Denver study additional measures to prepare the City for the possible local impacts of climate change.

IMPROVING OUR ENVIRONMENT — TREE BY TREE

TREES HELP TO COMBAT GLOBAL WARMING BY ABSORBING CARBON DIOXIDE (A GREENHOUSE GAS) AS PART OF PHOTOSYNTHESIS. THEY ALSO PROVIDE SHADE, REDUCING THE NEED FOR ENERGY TO BE GENERATED TO COOL STRUCTURES. (ENERGY IS LARGELY DERIVED FROM THE BURNING OF COAL AND NATURAL GAS — WHICH PRODUCES CARBON DIOXIDE).

IN JULY 2006, MAYOR HICKENLOOPER ANNOUNCED AN AMBITIOUS TREE-PLANTING INITIATIVE. THE GOAL OF **TREE BY TREE — THE MILE HIGH MILLION** IS TO PLANT 1 MILLION NEW COLORADO-FRIENDLY TREES IN METRO DENVER BY 2025. THE UNDERLYING GOAL IS MUCH BROADER: SOW THE SEEDS OF A SUSTAINABLE CITY. STUDIES SHOW THAT TREES ALSO YIELD ENVIRONMENTAL AND ECONOMIC BENEFITS, INCLUDING EROSION AND AIR POLLUTION CONTROL, REDUCED NOISE, AND HIGHER PROPERTY VALUES; AND SOCIAL BENEFITS SUCH AS REDUCED CRIME AND HIGHER TEST SCORES. THEY ALSO ADD BEAUTY TO OUR NEIGHBORHOODS.

THE **TREE BY TREE** PROGRAM IS A HIGHLY PARTICIPATORY COMPONENT OF GREENPRINT DENVER. WHILE OTHER ELEMENTS OF GREENPRINT DENVER ARE FOCUSED ON CITY OPERATIONS AND PUBLIC POLICY, **TREE BY TREE** TAKES THE GREENPRINT VISION TO THE STREETS. IT ENGAGES THE ENTIRE COMMUNITY IMMEDIATELY, RESULTING IN SUSTAINABILITY IN ITS BROADEST SENSE — IN SOCIAL, ECONOMIC, AND ENVIRONMENTAL BENEFITS.

Global Challenges and Local Opportunities

There is widespread scientific consensus that societal emissions of greenhouse gases are impacting the Earth's climate system, threatening the productivity and even the survival of our natural and economic systems. Societal emissions of the three dominant greenhouse gases — carbon dioxide (CO₂), methane (CH₄) and nitrogen oxides (NO_x) — come almost entirely from the burning of fossil fuels such as coal, natural gas, gasoline, and diesel. The supply of cheap fossil fuels is on the decline and the United States is highly dependent on vulnerable foreign supplies to meet its demand for fossil fuels. Clean and stable energy supplies are one of the most important challenges to the sustainability of our society.

Adverse public health impacts from the burning of fossil fuels, particularly gasoline and coal, have long been understood and are becoming increasingly evident. Fine particulate matter generated can lodge in the lungs and cause irritation and other pulmonary difficulties. The elderly, the young, and asthmatics are particularly susceptible. Nitrogen oxides and unburned fuels (containing volatile organic compounds or VOCs) combine with sunlight to form ozone which results in ground-level smog — an issue of special concern in Denver's high-altitude environment. Indirect health impacts from climate change are beginning to occur as well. Summer heat waves and extreme weather events are increasing in duration and intensity, leading to distress and fatalities.

As our climate continues to change, we are likely to see disruption of certain sectors of the economy. Scientists forecast dramatic changes in agricultural output due to unpredictable weather patterns and water production, which is also likely to be reflected at the local level, where semi-arid, dry-land farming is a challenge in much of the region. Many winter sports, including the skiing and snowmobiling industries, are dependent upon cold temperatures and adequate snowfall to thrive. With reductions in cold weather and potential disruptions in precipitation, these industries would be negatively impacted. Significant reductions in total snow pack, related river flows and water supply would also have major implications for both growth and tourism statewide.

With a better understanding of the real and potential environmental, economic, public health, and security impacts associated with traditional energy sources, there has been a dramatic increase in recent years in cleaner and more efficient energy sources and technologies. Many of these new industries and programs bring with them exciting new technologies and strong economic growth opportunities. As a leader in both traditional energy sources and emerging technologies, Colorado stands poised to become a leader in the transition from extractive to renewable resources; and Denver to become the nexus of this effort.

Recent news stories suggest there is growing economic activity around this transition:

- New wind energy farms have recently been announced by BP and Florida Power & Light in eastern Colorado.
- Ground has been broken for a major solar electricity generating station developed by Sun Edison in the San Luis Valley.
- Vestas, a major wind energy producer from Denmark, has announced a wind turbine blade manufacturing plant for northern Colorado.
- Biodiesel and ethanol fuels production facilities in the Denver area have seen substantial growth, along with crop producers that support these fuels.
- The number of service providers associated with energy efficiency projects is showing strong growth.
- Markets for recycled materials continue to improve, as do the recycling efforts of residents, businesses, and institutions.
- Local agricultural producers are supporting an emerging “Buy Local” ethic.
- New technologies for clean coal and natural gas are under active development.

Greenprint Council Statement of Values

The recommendations we provide are but a subset of the thousands of ideas and policies available. While our evaluation criteria involved technical, economic, and political considerations, this report represents a consensus belief that **Denver’s approach to climate change must be effective, measurable, and capable of attracting the widest possible public support.**

We recognize that regulations may in some circumstances be necessary; however, a solely regulatory approach to greenhouse gas reduction has typically fallen short of achieving meaningful goals. Rather, we believe the solutions to these issues need to be tightly integrated with market-based incentives, fully engaging of our diverse communities and inspiring to Denver’s citizens and businesses. This will allow our City to reach for the positive economic potential of sustainable change.

Inherent in our deliberations was a desire to establish Denver as a recognized model of civic commitment to sustainability. Meeting this threshold will require bold and substantive leadership. The tough choices around fiscal commitments, policy decisions, and transformative change in municipal practices will not be easy, nor will they occur quickly or without dissent. Yet these issues represent the defining challenge of our times.



With the above in mind, the Greenprint Council agreed on the following goals and guiding principles:**Goals**

1. Establish quantitative greenhouse gas emissions goals and committed deadlines.
2. Establish our community as a national leader in sustainability practices.
3. Position Denver’s municipal government to provide leadership by example.

Guiding Principles

1. Think big — the challenges are significant and reaching meaningful goals requires big ideas and a commitment to practical, attainable solutions.
2. Address all aspects of the challenge: supply side, demand side, efficiency gains, and public engagement.
3. Harness the power of the marketplace: solutions should foster a business climate that encourages broad adoption. Regulations should be prudent and reflect extensive input from the voices of economic development.
4. Embrace the opportunity to foster a whole new cycle of innovation and economic development around sustainability and renewable energy.

Greenprint Council Planning Process

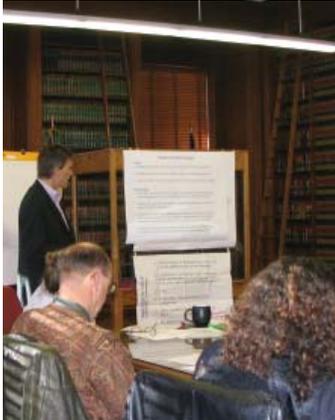
Working with staff from the City and faculty and students from the University of Colorado at Denver's Urban Sustainable Infrastructure Engineering Project, the Mayor's Greenprint Council met intensively over a 7-month period to:

- inventory the makeup of Denver's greenhouse gas emissions,
- study the successes and failures of other similar City efforts,
- evaluate a range of proposed actions, and
- develop a set of recommendations to the Mayor.

Over this period, the Mayor's Greenprint Council studied an inventory of sources of greenhouse gas emissions from the major sectors in Denver (transportation, buildings, and materials/waste), and identified a range of potential strategies to reduce emissions. A variety of expert presenters, both local and national, shared best practices learned from other cities to reduce greenhouse gas emissions and ways to engage citizens in sustainability practices. Many of the recommended strategies are based on precedents and effective implementation in other cities and states.

The Mayor's Greenprint Council recognized, early in their deliberations, that any successful strategies required an understanding both of technological tools (better building materials, more efficient lighting, improved transportation options) and effective outreach and engagement strategies (marketing, policy and/or market incentives) to achieve the desired impacts. For every effective technology, an understanding of the "target audience" and effective means of encouraging adoption of the technology is necessary. For example, the business community needs to understand both the adverse economic impacts that could result from continued climate change as well as the costs and benefits that could accrue from the development and implementation of new technologies, including competitive advantages that could be realized through the adoption of sustainable business models.

The recommendations contained in this report represent a mix of voluntary measures, market incentives, and behavior change strategies to achieve our reduction goals. In some instances, the Council determined that public policy mandates were desirable to achieve greenhouse gas reduction targets.



Section 2: Denver's Greenhouse Gas Inventory

NOTE: The following section is condensed from a larger report, "Greenhouse Gas Inventory for the City and County of Denver," prepared by The Urban Sustainable Infrastructure Engineering Project of the University of Colorado at Denver in February 2007 under the direction of Dr. Anu Ramaswami, through a contract with the Department of Environmental Health of the City and County of Denver. The complete inventory can be viewed electronically at www.greenprintdenver.org or requested via the Denver Department of Environmental Health.

Inventory Objectives

The objective of this inventory is to determine Denver's greenhouse gas emissions for the baseline years 1990 and 2005, in order to develop the targets for 2012 and beyond.

The inventory covers the three main greenhouse gases: carbon dioxide (CO₂), methane (CH₄), and nitrogen oxides (NO_x). The unit of measure being used for greenhouse gas emissions throughout this report (as well as in the inventory itself) is a metric ton of CO₂ equivalents (abbreviated mtCO₂e). Using an equivalence factor allows common comparisons to be made between a variety of greenhouse gases and relate them to the most prevalent one (carbon dioxide), even though each greenhouse gas has a different potential for global warming due to differing characteristics in the atmosphere. Using the common metric — mtCO₂e — provides the ability to compare the greenhouse gas impacts of widely different activities — such as the installation of a solar plant at DIA against a program that encourages the use of alternatively fueled vehicles.

The inventory accounts for greenhouse gas emissions attributable to:

- The City and County of Denver, referred to as "Denver" or the "community."
- City and County of Denver government, referred to as the "City" or "City government."
- Denver International Airport (for 2000 and 2005) and Stapleton International Airport (for 1990), both of which are referred to as "Airport" or "Denver's Airport" unless otherwise specified.

Inventory Method

Consistent with employment, traffic, and resource dynamics of all major cities, Denver is a demand center for energy and materials. Using the city-as-demand-center framework, the greenhouse gas inventory covers three different aspects of energy and material flows in cities:

- 1. Buildings and Facilities:** Community-wide greenhouse gas emissions from energy use in residential buildings and industrial/commercial facilities.
- 2. Transportation:** Community-wide tailpipe greenhouse gas emissions for transportation of goods and people to and from the City, including surface and airline transport.
- 3. Materials:** Community-wide greenhouse gas emissions from producing critical urban materials (food, water, fuel, and concrete) demanded by Denver residents, and from waste disposal.



NOTE: The Clean Air Climate Protection Software developed by ICLEI — Local Governments for Sustainability was used to determine greenhouse gas emissions from direct end use of energy in cities in the Buildings and Transportation sectors noted at left. Consistent with World Resource Institute protocols, life-cycle-based methods developed by the University of Colorado at Denver's Urban Sustainable Infrastructure Engineering Project were used to quantify the greenhouse gas impacts of demand for critical urban materials. This is an aspect that distinguishes the Denver greenhouse gas inventory from many community scale inventories, and is highly consistent with national and statewide per capita data.

Inventory Results

Summary results from Denver's greenhouse gas inventory for 2005 and contributions from various sectors are shown in Figure 2-1. Figure 2-2 shows the greenhouse gas emissions by fuel type.

Figure 2-1

Greenhouse gas emissions summary by sector for Denver in 2005

2005 total greenhouse gas emissions = 14.6 million metric tons CO₂e

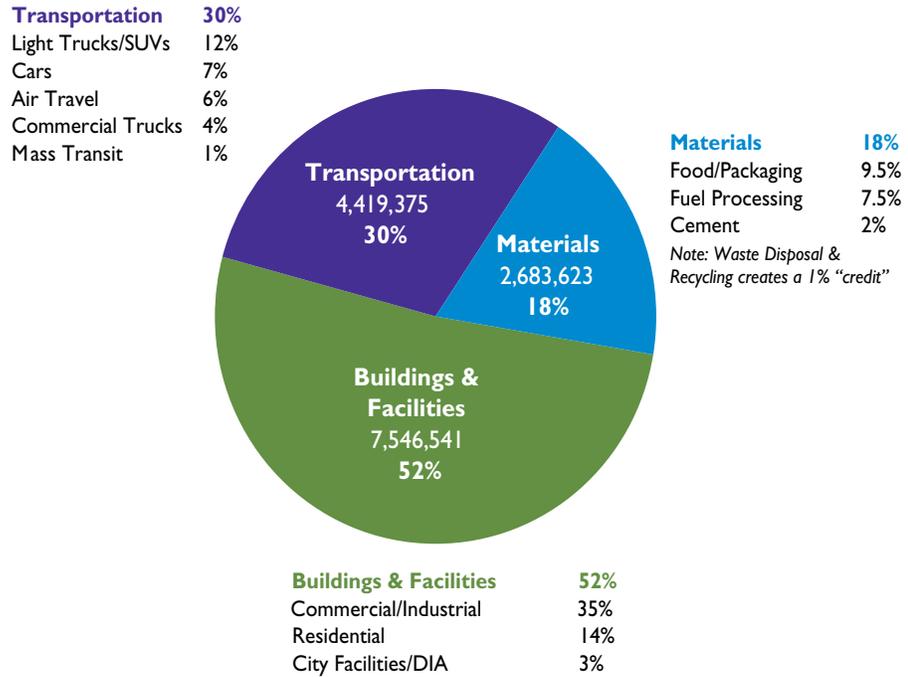
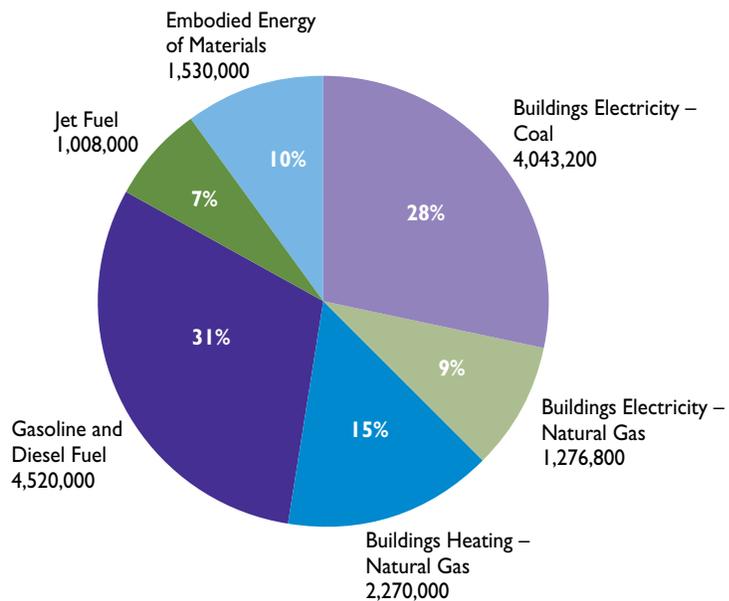


Figure 2-2

2005 greenhouse gas emissions summary by source type for Denver.

Emissions are shown as metric tons of CO₂ equivalent, along with percent of overall inventory and include all emissions from the processing of transportation fuel: extraction, refining, transportation and engine combustion of fuel.



Key Findings

Denver’s Community-wide Greenhouse Gas Emissions Trends: Denver’s annual greenhouse gas emissions increased 24 percent between 1990 and 2005, from 11.8 million mtCO₂e to 14.6 million mtCO₂e.

Denver’s Per Capita Greenhouse Gas Emissions Trends: Denver’s population also increased by 24 percent from 1990 to 2005, resulting in annual per capita greenhouse gas emissions of 25.3 mtCO₂e in both 1990 and 2005. Therefore there has been no statistically significant change in annual per capita greenhouse gas emissions between 1990 and 2005.*

**The average individual’s annual greenhouse gas production is 15 mtCO₂e; commercial, industrial, and government activities that support the individual contribute the balance of about 10 mtCO₂e (see page 16).*

25.3 mtCO₂e represents the number of tons of CO₂ gas that would fill up 25 30-foot diameter balloons. If we took the carbon alone, it would be 6.9 tons of pure carbon. This is equal to a cube of coal 8.7 feet on a side (assuming we used the same kind of coal we burn in the majority of our power plants: subbituminous coal from Wyoming which is ~65 percent carbon).

Denver’s Goals for Year 2012: Denver’s greenhouse gas emissions trends and goals are shown in Figure 2-3. Based on the target of a 10 percent per capita reduction relative to the 1990 baseline, Denver’s per capita greenhouse gas goal for 2012 is 22.7 mtCO₂e per person. To achieve this goal, Denver will have to reduce its community greenhouse gas emissions by 1.8 million mtCO₂e from expected 2012 business-as-usual levels.

Denver’s Goal for the Year 2020: As seen in Figure 2-3, Denver’s 2020 goal is to get below 1990 greenhouse gas emissions levels. This will require community-wide mitigation of 4.4 million mtCO₂e from expected 2020 business-as-usual projections.

The 2012 goal will mitigate 1.8 million mtCO₂e annually, equivalent to eliminating the need for one coal-fired power plant. The 2020 goal will mitigate 4.4 million mtCO₂e annually, equivalent to removing two coal-fired power plants.

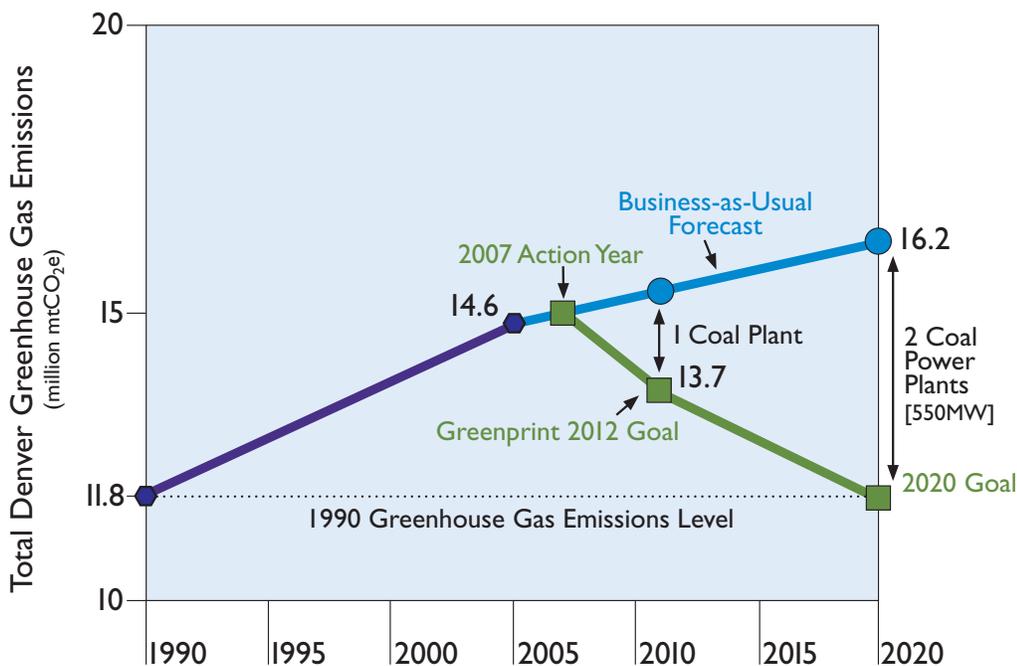


Figure 2-3

Denver’s community-wide greenhouse gas emissions projections with and without recommended actions.

Emissions are shown as metric tons of CO₂ equivalents. Business-as-usual scenario incorporates population growth with assumed steady per capita emissions of 25 mtCO₂e.

Sector Highlights

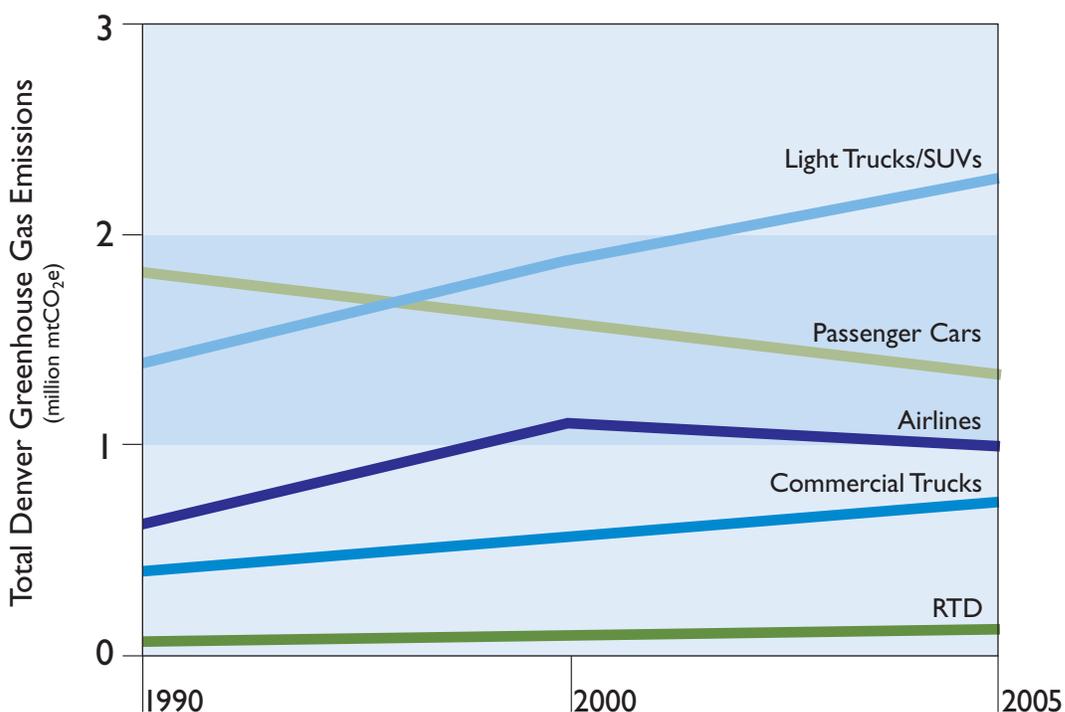
Commercial-Industrial Buildings and Facilities Sector: The commercial-industrial sector dominates greenhouse gas emissions at 35 percent of the total in 2005.

- Denver's per capita commercial-industrial greenhouse gas emissions increased significantly from 9.1 to 9.4 mtCO₂e per person from 1990 to 2005.
- Energy intensity of the commercial-industrial sector also increased by 6 percent from 222 to 236 kBtu/sq ft from 1990 to 2005.
- Better separation of commercial and industrial spaces and energy use is needed to understand underlying causes for this increase.

Transportation Sector: Tailpipe emissions from various modes of transport (surface and airline) are the second largest greenhouse gas contributors at 30 percent of the total (see Figure 2-1).

- Denver's per capita transportation greenhouse gas emissions — which include personal road and air travel, and commercial traffic — increased from 7.4 to 7.6 mtCO₂e per person from 1990 to 2005.
- Increased per capita airline travel and increased use of less efficient SUVs for surface transport from 1990 to 2005 are likely contributing factors (see Figure 2-4).

Figure 2-4
Transportation greenhouse gas emissions by mode of transport (in million mtCO₂e).



Materials Sector: Materials have a significant (18 percent) impact on Denver's greenhouse gas emissions.

- Food and packaging wastes contribute 10 percent to our current greenhouse gas footprint. Energy recovery from food waste (e.g., restaurant waste grease) and packaging wastes can mitigate some of these emissions.
- Adopting green fuels such as biodiesel and ethanol can avoid up to 7 percent of our current greenhouse gas emissions attributed to the refining of transportation fuels.
- The manufacture of urban concrete alone contributes about 2 percent to our current greenhouse gas emissions, in the same range as all City government operations combined. Each ton of Portland cement avoided saves one ton of CO₂ emissions.

Residential Building Sector: Residential energy use (from coal and natural gas) is the third largest single contributor to Denver’s greenhouse gas emissions, at 14 percent of the total in 2005.

- Denver’s per capita residential greenhouse gas emissions decreased significantly between 1990 and 2005: from 4.1 to 3.6 mtCO₂e. Some of this result may be attributed to Xcel Energy’s data reporting methods.
- However, Xcel Energy’s data also show that the average Denver home uses about 17 percent less electricity and 10 percent more natural gas when compared to the average Colorado home, based on 2003 data for both regions.

City Government & DIA Facilities: Greenhouse gas emissions from City government and Denver International Airport activities — offices, facilities, and fleets — contributed 3 percent of the total in 2005 (about 360,000 mtCO₂e).

- Emissions associated with DIA buildings and operations contributed 211,000 mtCO₂e of these emissions, with electricity use itself contributing 185,000 mtCO₂e (228 million kWh).
- Emissions associated with City government buildings and facilities accounted for 147,000 mtCO₂e, with the operation of streetlights and traffic signals alone comprising 50,000 mtCO₂e of that total.
- The energy use in City government buildings and facilities has increased by 21 percent from 2000 to 2005. The increase appears to be more closely related to an increase in City government building space, which increased by 37 percent, rather than a growth in the number of employees, which has not changed much.

	Denver’s 2005 Per Capita Greenhouse Gas Emissions (mtCO ₂ e per person)	National, State & other Cities’ Per Capita Greenhouse Gas Emissions (mtCO ₂ e per person)
Direct energy use plus airline travel and key materials	Denver: 25.3	National ¹ : 25 Colorado ² : 24.3
Direct energy use (no airline travel, fuel refining or production of concrete, food and food packaging)	Denver: 19.1	Other Colorado Cities ³ : 18.4 – 19.6 Other U.S. Cities ⁴ : 12.5 – 14.4

Table 2-1

Denver’s per capita greenhouse gas emissions compared to the national average, State of Colorado average, and to other cities both within and outside of Colorado.

1. National annual greenhouse gas emissions increase of 2 percent was applied from 2004 (EIA inventory year) to 2005. [EIA Voluntary Reporting of Greenhouse Gases]
2. Draft Greenhouse Gas Inventory for the State of Colorado. [Colorado Greenhouse Gas Emissions Inventory, Revised 2002]
3. Other local communities’ greenhouse gas emissions inventories (Boulder, Fort Collins) from 2003 and 2004.
4. Cities include Portland (all of Multnomah County) [Multnomah County Global Warming Progress Report 2005] and Seattle [Seattle’s Greenhouse Gas Emissions 2002]. Seattle’s greenhouse gas inventory does include a proportionate amount of emission from their two airports but does not include any other emissions outside of the cities’ physical boundary.

Comparisons with Other Cities and National Data

- **Comparison with National Average:** When emissions from key urban materials and airline travel are included in Denver’s greenhouse gas footprint, per capita greenhouse gas emissions for 2005 (25.3 mtCO₂e/person) coincide closely with the national average (25.0 mtCO₂e/person, see Table 2-1). Denver’s per capita emissions also coincide with the per capita emission computed for the State of Colorado. This consideration of both key urban materials and airline travel allows for a more complete estimation of a city’s greenhouse gas footprint. Urban materials and airline travel have not usually been included in other cities’ inventories, making their greenhouse gas footprint appear lower than the national average.
- **Compatible with Surrounding Cities:** Denver’s per capita greenhouse gas emissions, without the inclusion of airline travel and key urban materials, were 19.1 mtCO₂e per person for 2005. This is comparable with per capita emissions of other cities in the region; however, differences among data sets and the time of data collection makes such comparisons more difficult. Comparisons with cities in other regions may not be appropriate due to climate variability significantly impacting building energy use.

What do Per Capita Greenhouse Gas Emissions Mean to Denver Citizens?

As Denver develops policies to decrease its per capita greenhouse gas emissions from the current level of 25.3 metric tons of CO₂e per person, it is important to understand what the CO₂e emissions mean to the individual. Table 2-2 translates CO₂e per capita emissions from various activities and sectors to more readily understood measures, such as miles driven, natural gas burned for heating, and electricity usage.

What are “Per Capita Emissions”?

When discussing greenhouse gas inventories, “total emissions” and “per capita emissions” are commonly used terms. When making comparisons between other cities or other countries, per capita emissions are a useful metric that help to normalize what are otherwise very big numbers (i.e., millions or billions of tons). For example, if two countries have the same total emissions of 20 billion tons each, but one country has three times the population, then per capita emissions in that country will be 1/3 that of the other. There could be many reasons for the per capita differences, including more or less development or prosperity, warmer versus colder climate, better urban planning policies, or higher nuclear versus fossil-fueled power generation.

For the entire Earth’s atmosphere, though, total emissions are the only important metric to consider and the consensus is that total emissions must be reduced.

“Per Capita” versus “Personal” Emissions — Per capita emissions provide a fuller picture of an individual’s actual greenhouse gas footprint by incorporating commercial, industrial, and city government sectors, which provide essential goods and services to the individual. 2005 per capita emissions of 25.3 mtCO₂e are therefore higher than personal emissions, which are roughly 15 mtCO₂e per person.

Table 2-2
Understanding Denver’s per capita greenhouse gas emissions, by activity.

Sector	Greenhouse Gas Emissions (mtCO ₂ e per person)	Measure for Comparison (current Denver average unless otherwise stated)
Transportation	Gas, Trucks, SUVs 5.1	Personal miles driven (national average): 29 vehicles miles/driven/day
	Air Travel 1.4	Miles flown: 2,700 miles/person/year (national average)
Materials	Fuel Processing 1.9	CO ₂ e emitted per gallon of fuel produced 2.4 kg CO ₂ e/gal
	Food & Packaging 2.4	Tons of household waste 0.83 tons/person/year
	Concrete 0.5	Tons of new cement 0.52 tons/person/year
Buildings and Facilities	Residential 3.6 ¹	Household energy use Electricity = 568 kWh/mo Natural Gas = 63 therms/mo
	Commercial, Industrial, Government 10.4 ¹	Commercial, industrial energy use 236 kBtu/sf

¹The types of fuels used to generate electricity affect the greenhouse gas emissions from power plants. Current Xcel Energy emissions factor = 1.75 lb CO₂e/kWh.

Section 3: Recommendations

The following recommendations, if fully implemented, will demonstrate Denver's serious commitment to addressing the problem of global warming by reducing annual greenhouse gas emissions by 1.8 million metric tons by 2012, thus fully achieving Denver's 2012 goal. Several additional priority activities for Denver to support at the regional, state, and federal levels are also provided. Finally, a set of secondary strategies is listed in Appendix B.*

Criteria and Recommendations

In analyzing the wide variety of options available to reduce greenhouse gases, the Mayor's Greenprint Council applied the following criteria to their process of review and deliberation:

- **Viability** – Is the proposed action financially, technologically, and politically viable?
- **Cost-effectiveness** – Applying full-cost accounting principles, are the distributions of costs and benefits equitable and reasonable?
- **Implementability** – Is there a readiness to implement and are the potential barriers to implementation low?
- **Achievement of goals** – Does the proposed action contribute to short- and long-term reduction goals? Is there a cumulative impact over time?
- **Engagement** – How can the impact potential of the proposed action be balanced with the potential for public engagement and education?

With the above criteria in mind, the Mayor's Greenprint Council recommendations are presented below, as:

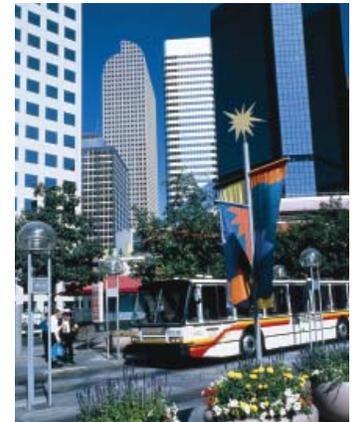
- Primary Denver Strategies
- Suggested Regional and Statewide Initiatives

Primary Denver Strategies

The following recommendations are the significant actions intended to reduce greenhouse gases in Denver. Each of these actions is listed in further detail on a separate summary sheet. The summary sheet provides narrative information regarding each option, its projected contribution toward Denver's greenhouse gas reduction goal, the initial cost, other costs associated with implementing the measure, and any additional assumptions.

1. **Corporate and Residential Climate Challenges** (28 percent toward 2012 goal) — Develop major business and residential outreach campaigns supporting the adoption of best practices related to energy conservation, purchase of renewable energy, support for multi-modal transportation, and waste reduction in the commercial and residential sectors.
2. **Incentivize Energy Conservation** (25 – 40 percent toward 2012 goal) — Introduce a proposal to apply a tiered rate structure to electrical and natural gas usage. Similar to water-use rate charges, such electrical and natural gas tiered rates would impose a premium charge for excessive electrical and natural gas usage. Voter approval should be sought for this measure. Funds generated would be used to support energy conservation and greenhouse gas reduction programs, especially for lower-income neighborhoods.
3. **Voluntary Travel Offset Program** (20 percent toward 2012 goal) — Provide the opportunity to pay a small voluntary fee, at the time of air travel or motor vehicle registration, to offset the carbon emissions related to travel. Funds would be used for carbon-absorbing or carbon-reducing activities. Explore potential partnership with the Governor's Energy Office to develop local offset investment opportunities.

** In parallel with these actions that reduce energy use and increase the penetration of renewables, care must be taken to ensure that other factors, such as a significant increase in the use of air conditioners, do not offset the energy efficiency gains projected from these actions.*



4. **City Leading by Example** (9 percent toward 2012 goal) — In addition to the 5-year goals for City practice improvements outlined in the 2006 Greenprint Denver Action Agenda, aggressively pursue opportunities for energy efficiency and renewable energy at Denver International Airport, work to develop “carbon neutral” City buildings through application of energy efficiency savings to the purchase of Windsource, and make additional City fleet improvements.
5. **Enhance Recycling Programs** (2 percent toward 2012 goal) — Support new and expanded recycling initiatives throughout Denver, including multi-family, commercial, and green waste recycling, as part of the development of a comprehensive Solid Waste Master Plan. The goal is to double the present recycling rate, which contributes to both energy and greenhouse gas savings.
6. **Energy Efficiency Standards for New Buildings and Remodels** (4 percent toward 2012 goal; long-term {2020} impact up to 12 percent) — Adopt a set of mandatory building standards for commercial buildings and building codes for new homes and some remodels that incorporate energy efficiency standards and renewable energy requirements.
7. **Increase Energy Efficiency in Existing Homes** (1–4 percent toward 2012 goal; more than 10 percent toward long-term {2020} goal) — Promote basic energy efficiency measures at residential properties as a way to improve the energy efficiency of older housing stock. Incentives to plant shade trees and install in-home energy display systems would enhance the effectiveness of this program.
8. **Community-wide High-performing Green Concrete Policy** (3 percent toward 2012 goal) — Require, through City policies, the use of “green” concrete, containing a low to moderate percentage of fly ash, in all public and private construction projects. Pilot projects are recommended using both fly ash and recycled aggregates, in public and private projects to evaluate the feasibility of large-scale implementation.
9. **Compact Growth Boundary with Incentives for Density in Urban Areas** (2 percent towards 2012 goal; greater than 10 percent by 2020) — Support maintenance of the existing DRCOG growth boundary and support additional population growth around transit in the metro area to promote denser, more pedestrian-, bicycle-, and transit-friendly neighborhoods that will reduce the demand for motorized personal transport.
10. **City Support for Alternative Transportation Strategies** (~2 percent toward 2012 goal) — Develop various City policies that promote the transition over time to the use of alternative transportation sources (such as bicycles, telecommuting, walking, van/car pools, and mass transit). These strategies may also include the promotion of alternatively fueled and high-fuel economy vehicles, including parking subsidies, car-share programs, and access fee discounts for hybrid taxis at DIA.



Taken together, these strategies will result in the mitigation of approximately 1.8 million metric tons of climate-changing greenhouse gases annually by 2012, decreasing Denver’s per capita greenhouse gas footprint by 10 percent from 1990 levels. The projected annual impact of the ten primary actions is shown in Figure 3-1. Actions that are expected to have an increased impact over time (to Year 2020) are highlighted in green.

Each of the primary recommendations is specifically summarized in the following pages, which provide a description of the proposed recommendation, the contribution of the recommendation in meeting Denver’s greenhouse gas reduction goal by 2012, the initial cost per metric ton of carbon dioxide (equivalents) mitigated, the total participant cost or investment, the expected 2012 participation rate, and additional assumptions.

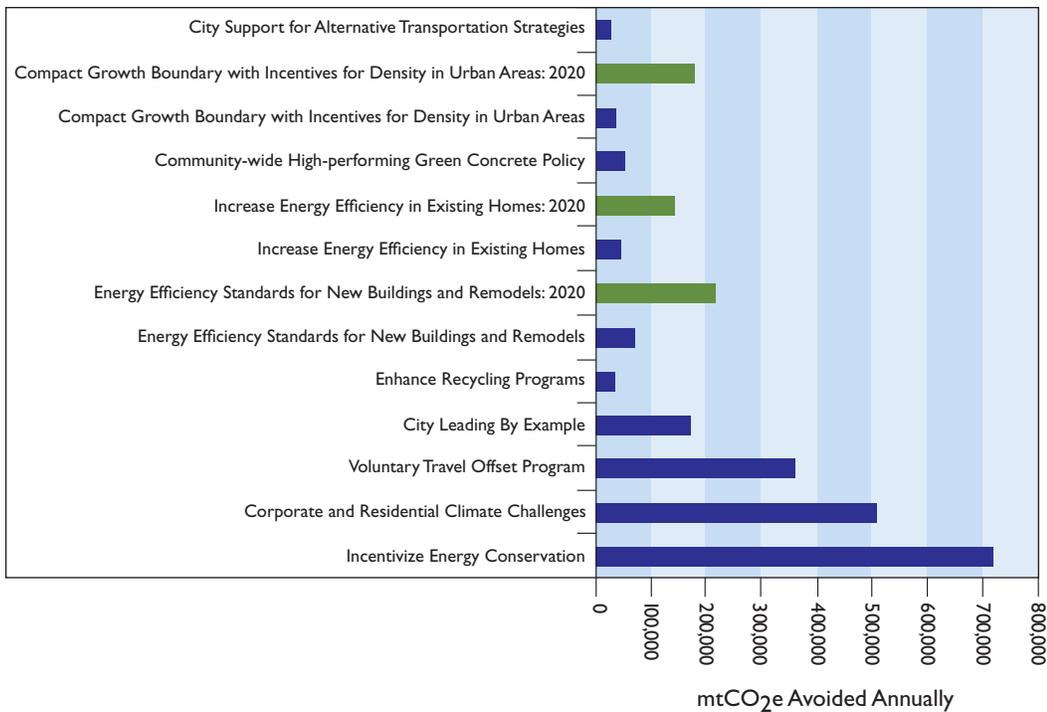


Figure 3-1
Expected 2012 (blue) and 2020 (green) greenhouse reductions.

Regional, State, and Federal Strategies

The Greenprint Council supports a variety of additional actions (listed below) available to policy makers at the regional, state, and federal levels that could result in reductions in greenhouse gas emissions over and above the amounts to be realized from strictly local efforts. Taken together, these actions could have an additional 50 percent or greater impact on Denver’s per capita greenhouse gas reduction goals.

GENERAL INITIATIVES

- **Energy conservation power plant** — Support implementation of statewide conservation tracking system that identifies cumulative benefits as “power plants avoided”
- **Statewide carbon offsets in local projects** — Support development of investments from local carbon offset purchases, in order to make impacts visible and immediate
- **Renewable energy and conservation investment program** — Support development of favorable financing for technologies that advance clean energy options.
- **Supply side study** — Recommend that a state-level technical agency, such as the Public Utilities Commission, study the technical, economic, and environmental feasibility of further promotion of alternative energy sources that are lower carbon-emitting sources including (but not limited to) wind, solar, geothermal, natural gas, clean coal, nuclear, and energy efficiency technologies. The State of Colorado should show a preference toward those energy sources that have the least impact in terms of economic cost and environmental impact.¹

1. A minority of the Greenprint Denver Council believes that nuclear energy should not be included as a suggested alternative energy technology to even be considered for feasibility analysis by the State of Colorado, due to several factors: (1) the development of nuclear power plants and the associated mining and shipping of nuclear fuel are both associated with significant greenhouse gas emissions, and thus, this alternative is not a dramatically improved alternative to fossil fuel-based sources; (2) the issue of proper disposal of nuclear waste has yet to be satisfactorily resolved; and (3) the threats from the proliferation of nuclear technology, fuel supplies, and waste materials into unauthorized hands is a real and growing danger in today’s society.

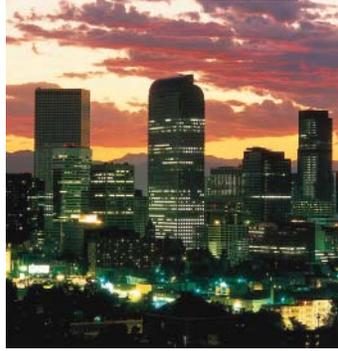
BUILDINGS AND POWER SECTOR

Estimates are provided below showing the extent these measures would contribute to Denver's 2012 goals. For many measures, the time needed to fully penetrate is an important factor. So even though 2012 impacts may be small, the long-term impacts should be much greater, as in the case, for example, of adopting Clean Car Standards.

- **Make smart meters with time-of-use pricing available for all homes** (7 percent toward Denver's 2012 goal) — The program will enable in-home energy use displays, or smart meters, to be installed in every residence. The use of smart meters will enable families to “see” home energy use in real-time on electronic displays, improving home energy conservation by at least 10 percent. A statewide mandate could increase the smart meter penetration rate from 10 percent of homes to 100 percent.
- **Link 20 percent of the renewables portfolio with a 5 percent greenhouse gas emissions reduction goal** (8 percent to Denver's short-term {2012} goal; 16 percent long term {to 2020}) — This would be similar to bills passed by a number of states — including New York, New Jersey, Connecticut, Vermont, New Hampshire, Delaware, Maine, and Massachusetts — that established a cap-and-trade program with the goal of reducing greenhouse gas emissions by 10 percent by 2019 through a combination of demand side management (DSM), offsets, renewables, and conventional plants. It is expected that Xcel Energy's increase in renewables, as a result of the renewable portfolio standard (RPS, passed through Amendment 37, and increased this year through House Bill 1281), may not result in a reduction of their overall emissions because of an increasing percentage of energy production from new coal plants. Linking a statewide emissions factor reduction requirement to the 20 percent renewables legislation will ensure a reduction in carbon emissions for electricity production.
- **Approve Xcel Energy's natural gas Demand Side Management (DSM) program for utilities** (3 percent toward the 2012 goal) — A natural gas DSM program — similar to Xcel Energy's current DSM program for electricity — would require that Xcel Energy provide a combination of rebates, incentives, and design assistance to help Colorado commercial and residential customers reduce their natural gas use.
- **Statewide policy for more energy-efficient appliances** — This policy would provide rebates for appliances with an Energy Star® rating or better, or possibly mandate higher energy-efficiency standards for appliances sold in the state.
- **Advocate before the Public Utilities Commission for rate structures that will motivate conservation** — examples are time-of-use and inclining block rates.

TRANSPORTATION SECTOR

- **Statewide Pay-as-You-Drive Auto Insurance** (12 percent toward 2012 goal if implemented across the State) — Unlike conventional auto insurance policies, which charge a flat rate based on time periods and result in overcharging low-mileage drivers and providing an incentive to drive more, pay-as-you-drive (PAYD) auto insurance policy costs are based on usage or distance driven. PAYD policies still incorporate traditional rate factors like driver history, location, age, and vehicle type. The premium cost added to those factors is simply calculated per-mile or per-minute – the more you drive, the more you pay to be insured. PAYD policies reward drivers who use their car less, which has the potential to reduce traffic congestion, collisions, and vehicle emissions while increasing the number of insured drivers. PAYD has been piloted in Texas and is being developed in Oregon.
- **Western States Vehicle Feebate System** (13 percent toward 2012 goal) — Fees levied on higher emissions vehicles would be used to pay for rebates for lower emitting vehicles. This program encourages the market to shift toward lower greenhouse gas emitting vehicles.
- **Law to require the availability of low rolling resistance replacement tires** (up to 2.5 percent toward goal) — Such tires can increase fuel economy up to 3 percent (assuming a 10 percent participation rate).
- **RTD use of biodiesel [B20]** (less than 1 percent toward goal)
- **Increase federal CAFE** (Corporate Average Fuel Economy) **standards**



- **Adopt California’s Clean Car Program** (2 percent toward 2012 goal; much greater long term) — low-emission vehicle standards, advanced vehicle technology introduction standards, and tailpipe emission standards for greenhouse gas-related pollutants
- **Adopt a statewide renewable fuels standard** (9 percent toward goal) — 10 percent of state gasoline and diesel use would be replaced by renewable fuels such as bio-ethanol and biodiesel

MATERIALS AND WASTE SECTOR

- **Statewide demolition debris recycling program** (~2 percent toward goal) — State policy would require that at least 50 percent of demolition debris that can be recycled be removed by a contractor prior to final land-clearing activities at a demolition site.
- **Statewide green concrete program** (3 percent toward goal) — Mandate a statewide high-performing green concrete policy with at least 20 percent fly ash.
- **Statewide landfill management program** — Landfill gas-to-energy recaptured and emphasis on waste-to-energy.

Summary Regarding Strategies

The City should look beyond the achievement of its per capita reduction goals by 2012, and adopt absolute reduction goals to meet 1990 greenhouse gas emissions and reduce below 1990 levels by 2020. With contributions from state-level actions as well as the potential for much greater long-term impact from many of the proposed activities (most notably the increased energy efficiency in existing homes and commercial structures, energy efficiency standards for new construction, and increased density and support for compact urban growth), the City should establish a target of **absolute** (as opposed to per capita) reductions of greenhouse gas emissions over time of 25 percent by 2020, bringing us back to 1990 levels. As Denver monitors its progress, further refinements and additional strategies may be required to achieve the 2020 goal.

The most effective strategies are those that combine immediate reductions with ones that have a cumulative impact over time, and a portfolio of strategies that represents all emission sectors, so as not to unduly burden one particular sector of our energy infrastructure. Mandates, where applied, should be cost effective and of high impact, and activities that stimulate market activity through incentives or public policy should be given preference wherever possible. These strategies and their implementation are the best opportunities to engage the public in sustainable behavior over time. The City must also invest in the institutional capacity necessary to implement priority programs, to track their progress, to develop and maintain key partnerships, and adapt policies and programs moving forward to continue to achieve successful outcomes.

The following section provides summaries of the major recommendations of this climate action plan. Each summary sheet provides a more complete description of the recommended action, how much the action will contribute to Denver’s greenhouse gas reduction goals, the costs of the action, other investments, and expected participation rate.



DEMAND SIDE MANAGEMENT FROM XCEL ENERGY

ENERGY EFFICIENCY IMPROVEMENTS CAN BE IMPLEMENTED AT A BUSINESS OR INDUSTRIAL SETTING USING XCEL ENERGY’S DEMAND SIDE MANAGEMENT (DSM) PROGRAM. THE DSM PROGRAM CURRENTLY OFFERS UP TO A 50 PERCENT REBATE ON INVESTMENTS IN ENERGY EFFICIENCY UPGRADES, WHICH WILL SAVE MILLIONS OF DOLLARS FOR DENVER BUSINESSES OVER THE NEXT 5 TO 15 YEARS WHILE DECREASING OUR CARBON EMISSIONS. OPTIONS INCLUDE STANDARD PROGRAMS FOR IMPROVING THE EFFICIENCY OF COOLING, LIGHTING RETROFITS AND NEW CONSTRUCTION, COMPRESSED AIR, AND MOTORS, BOTH VARIABLE FREQUENCY DRIVER AND CONVENTIONAL. CUSTOM PROGRAMS ARE AVAILABLE FOR MEASURES NOT INCLUDED IN STANDARD PROGRAMS. ENERGY DESIGN ASSISTANCE IS AVAILABLE FOR NEW BUILDINGS, ADDITIONS, AND/OR SIGNIFICANT RENOVATIONS. RECOMMISSIONING IMPROVES THE EFFICIENCY OF EXISTING MECHANICAL SYSTEMS AND CONTROLS WITH LOW- OR NO-COST ADJUSTMENTS.

IN THE LAST DECADE, XCEL REBATES HAVE ALLOWED THE CITY TO REPLACE OVER 90 PERCENT OF ITS TRAFFIC SIGNALS WITH HIGH EFFICIENCY, LOW MAINTENANCE LEDs, SAVING THE CITY NEARLY \$1 MILLION PER YEAR IN ENERGY AND MAINTENANCE COSTS.

CORPORATE CLIMATE CHALLENGE

This program will engage Denver's corporations, industries, and businesses to reduce their greenhouse gas emissions through:

- **Energy efficiency improvements** using Xcel Energy's Demand Side Management (DSM) Program. Xcel Energy's DSM program currently offers up to a 50 percent rebate on investments in energy efficiency upgrades, which could save millions of dollars for Denver businesses over the next 5 – 15 years while decreasing our carbon emissions.
- Purchase of **carbon-neutral wind energy** (or other renewables such as solar power or geothermal energy). The current incremental price for Xcel Energy's Windsource program is ~1 cent/kWh.
- Expanded **employee commuter benefits**. Commuter benefits with the largest potential impact on greenhouse gas emissions are transit subsidies, vanpools, and cash in lieu of parking. Other commuter benefits include teleworking, bike lockers and showers, preferred car pool parking, compressed work schedules, shuttles, and rideshare matching. National studies show 0.5 mtCO₂e saved for every employee covered by the USEPA's "Best Workplace for Commuters" program.
- Offer **workplace recycling**, with approximately 4 mtCO₂e saved per ton of waste recycled.

Documentation of carbon mitigation that occurs via the above programs will be encouraged for annual corporate competitions and awards.

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal
19%



Initial Cost per Metric Ton of CO₂e Mitigated
\$10 – \$26/mtCO₂e



Total Participant Cost or Investment

- Cost of \$845K/year for Windsource purchases
- Investment of \$80M in DSM with a payback of 2 – 5 years
(Investment of \$65M in DSM may occur through Xcel Energy's current DSM efforts.)

Expected 2012 Participation Rate

- 10 percent of Denver businesses will use Xcel Energy's DSM program to conserve 280 GWh
- 25 percent of workers in employee commuter benefits, a doubling from 2005 participation
- 115 GWh of Windsource purchased by commercial entities, doubling 2005 purchases



RESIDENTIAL CLIMATE CHALLENGE

Outreach events and community partnerships will be used to conduct energy conservation, wind energy, and sustainable transportation challenges. The program will highlight the use of in-home energy display systems, which enable families to see home energy use and costs in real time on electronic displays. Such display systems have been shown to increase home energy conservation by at least 10 percent. Homeowners will also be encouraged to purchase carbon-neutral wind or solar power. A travel marketing pilot program will encourage sustainable transportation options. The Residential Climate Challenge will also create a package of programs to bring money-saving energy efficiency measures to homes, subsidized in part by the City. Key programs include:



- **Compact fluorescent lamps (CFL) program** – based on a very successful mail-in program in Seattle that was able to get more than half of the homes to begin using these energy-saving lamps. Switching from incandescent bulbs to compact fluorescent bulbs is one of the easiest ways to save energy through a simple and quick action. Compact fluorescent bulbs consume one-fourth of the energy and produce the same light output.
- **In-home energy display systems** — sometimes referred to as “smart meters”; efforts will be made to make these display systems as affordable as possible, through possible teaming arrangements with the Public Utilities Commission or Xcel Energy.
- **Free energy audits** — offered by several cities to help homeowners diagnose the best ways to improve the energy performance of their homes, by checking insulation, furnaces, boilers, etc.
- **Neighborhood energy blitz** — consists of a team driving through low-income neighborhoods, going door to door to bring a package of energy-saving items as well as basic education on energy conservation to homeowners. Door hangers are left with follow-up information, and a second visit follows the first. A blitz program in Los Angeles was able to engage 58 percent of the homeowners in low-income neighborhoods.
- **Individualized Travel Marketing Pilot** — contact homes by phone, mail, e-mail or in person and provide tailored information on available mass transit options.

Contribution to Denver’s Greenhouse Gas Reduction Goal

8% 

Initial Cost per Metric Ton of CO₂e Mitigated

\$10 – \$26/mtCO₂e 

Total Participant Cost or Investment

- Cost of \$900K/year for Windsorce; investment of \$150/home for smart meters with a payback of 2 – 4 years
- CFL program: Cost to City of \$1.4M; investment of \$800K with a payback of 1 – 2 years
- Energy audits: Cost to City of \$800K; investment of \$3.5M with a payback of 4 – 5 years
- Energy blitz: Cost to City of \$1.4M

Expected 2012 Participation Rate

- 10 percent of homes in Windsorce and using in-home energy display systems
- 54 percent of homes in CFL program
- 6 percent of homes in free energy audits
- 10 percent of homes in energy blitz
- Modeled after pilots in Seattle, California, and nationwide
- 15,000 homes reached by travel marketing pilot

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver’s 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

INCENTIVIZE ENERGY CONSERVATION

Implement a tiered rate for electricity consumption for homes and businesses that consume above average amounts of electricity and natural gas and that are not already participating in Windsource. The tiered rate could be a fraction of the incremental price to purchase wind energy, currently about 1 cent/kWh. Develop means to avoid the inequitable impacts on low-income residents.

On average, a flat rate of 0.1c/kWh rate translates to an increment of roughly 50 cents per home per month, and provides the same result as 10 percent of all electricity being purchased from Windsource (Denver's 2012 Goal). Revenues could be used to purchase renewable energy, invest in certified carbon offsets, and/or stimulate further energy conservation, especially in low-income neighborhoods.

If all of the revenues are applied to purchase Windsource or other equivalent carbon offsets, this action will achieve 25 percent towards Denver's 2012 greenhouse gas mitigation goal. Alternatively, if a portion of the revenues is used to provide a \$1 to \$2/mtCO₂e subsidy (or sales tax waiver) for 10 large energy conservation projects and 5 small neighborhood projects, this program would take us to 40 percent towards Denver's 2012 greenhouse gas mitigation goal over the next 4 years.

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal
25–40%



Initial Cost per Metric Ton of CO₂e Mitigated
\$10/mtCO₂e 

Total Participant Cost or Investment (based on applying a 0.1c/kWh increment to average energy use)

- Average cost to homes of \$6/home/year or \$1.3M total/year
- Average cost to businesses of \$130/business/year or \$4.2M total/year

Expected 2012 Participation Rate

- 100 percent of homes and businesses



VOLUNTARY TRAVEL OFFSET PROGRAM

This program will encourage the purchase of certified carbon offsets from high-visibility kiosks at DIA through time-of-purchase contributions and also through annual auto registration mailers. This will be a unique program pioneered at the gateway to Denver but which is easily replicable in other cities. Travel, particularly airline travel, is often difficult to reduce on a community-wide basis in the near-term, for which offsets can serve as a short-term alternative.

Carbon offsets fund projects with documented carbon reduction in other parts of the world, allowing the purchaser to “cancel out” some or all of the impact of their travel in Denver.

This program can be offered at three different levels:

- Stand-alone high-visibility kiosks could be used at DIA for quick implementation. 21 million people depart from DIA each year and incremental participation could have significant impacts.
- The City and County of Denver could work with airlines to incorporate the voluntary purchase of third-party certified carbon offsets with the purchase of airline tickets. Certified carbon offsets currently cost between \$10 and \$20 per metric ton of CO₂ mitigated.
- In the third and most complex option, airlines could channel the carbon offset funds to the Denver community. Greenhouse gas mitigation projects in Denver would need to be certified by a third party.



Contribution to Denver's Greenhouse Gas Reduction Goal

20%



Initial Cost per Metric Ton of CO₂e Mitigated

\$10/mtCO₂e **\$**

Total Participant Cost or Investment

- Cost of \$6/car/year to offset each 10 percent of auto travel, or 1,200 miles
- Cost of \$2.50 to offset a 1,000 mile air trip

Expected 2012 Participation Rate

- 7 percent of vehicles
- 10 percent of air travelers

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

\$ Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

CITY LEADING BY EXAMPLE

The actions listed below are designed to make Denver City government buildings and DIA up to 50 percent carbon neutral, while serving as a model for businesses in the community to follow.

- Pursue 10 – 20 percent energy savings at DIA and in existing City government buildings through **Xcel Energy's Demand Side Management (DSM)** program, which offers up to 50 percent rebates for implementation of custom energy efficiency improvements. These upgrades will require an initial investment, but offer significant cost savings and, therefore, a healthy return on investment over several years. Examples include motion sensor escalators and increased efficiency motors.
- Purchase carbon-neutral **Windsorce**. Funding for Windsorce and carbon offsets are expected to come from cost savings resulting from energy efficiency upgrades (explained above). City budgets would need to apportion a fraction of the money saved toward the purchase of Windsorce.
- **Mandate high-performing green concrete** with at least 20 percent fly ash for all Public Works projects. Denver would be the first city with a documented green concrete program. Credit sharing arrangements should be made with fly ash generators to share the carbon credit with Denver.
- **Increase City Fleet Motor Pool/Car-Share program**. Modeled after Philadelphia, this program divests infrequently used government vehicles while expanding the number of available car-share vehicles. Part of the profit from vehicle sales could be used to offset all other fleet travel.

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal

9%



Initial Cost per Metric Ton of CO₂e Mitigated

Savings – \$20/mtCO₂e 

Total Participant Cost or Investment

- Investment in DSM of \$3M with a net return of \$1M/year after Windsorce purchases
- Savings of \$550K/year from green concrete
- Savings of up to \$700K/year from car share



ENHANCE RECYCLING PROGRAMS

Through a variety of programmatic improvements, the City could achieve a significant increase in its solid waste recycling rates. The City Solid Waste Management Division (in the Department of Public Works) is in the process of developing a Solid Waste Master Plan over the next 18 months to 2 years to provide a framework for policy decisions, operational efficiencies, funding mechanisms, and waste diversion. The Greenprint Council commends Denver Recycles for its noteworthy improvements in residential and City facility recycling over the past few years, resulting in an increase of average weekly tonnage of recycled material processed by 63 percent in the most recent reports. The Greenprint Council recommends that the proposed Master Plan consider:

- Maximizing access to the existing Denver Recycles residential recycling program
- Investigating ways to increase the incentives for recycling
- Providing recycling programs to multi-family residences not currently served by Denver Recycles
- Promoting comprehensive recycling activities at commercial properties
- Expanding City facility recycling programs at City-owned public areas such as Red Rocks
- Developing a program for the collection and composting of “green” waste (grass clippings and lawn debris)
- Reviewing collection system efficiencies and accountability to promote source reduction/waste minimization

In addition, the Greenprint Council recommends that a public information campaign be initiated to discuss the total cost and sources of funding for the City’s current residential trash collection and recycling programs – to counter the public perception that trash collection is a “free” service, but is actually paid for by Denver taxpayers. Provide information and line-item highlights in taxpayer notices of the sources of revenue and expenses associated with City solid waste management services.

Also encourage consumers to purchase recycled-content products.

Contribution to Denver’s Greenhouse Gas Reduction Goal
2% 

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver’s 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.



ENERGY EFFICIENCY STANDARDS FOR NEW BUILDINGS & REMODELS



This program aims to increase the energy efficiency on a per square foot basis for both commercial and residential buildings. In both types of buildings, the cost premium to incorporate energy efficiency features (as seen through increased monthly mortgage payments) is usually offset by monthly savings on energy bills over time.

Recognizing that standards change over time, the Greenprint Council recommends that private building and infrastructure projects within the City and County of Denver comply with the Leadership in Energy and Environmental Design (LEED™) Silver standard, or an equivalent energy performance standard. Additionally, the Greenprint Council recommends the LEED Silver level of attainment, or equivalent energy performance standard, for existing buildings, increasing overall energy and environmental performance. With projects or developments where a LEED Silver level of attainment is not possible, such as with individual homes (LEED for Homes is currently only in the pilot stage), the Greenprint Council recommends that the EPA's Energy Star or an equivalent standard be applied.

The City currently requires that all public buildings achieve both LEED Silver and Energy Star ratings. LEED Silver and Energy Star typically double the energy efficiency benefits seen in the International Energy Conservation Code. As these and other performance standards continue to move toward higher levels of required energy efficiency, the Greenprint Council recommends that this recommendation continue to be reviewed and revised as necessary.

Residential and Commercial Building Standards, including standards for large multi-family housing, should include features such as solar systems, passive solar heating and cooling, building insulation levels, energy-efficient windows, natural day-lighting, etc. Some of the many long-term benefits include cost savings, increased workplace productivity, improved indoor air quality, energy conservation, water savings, and carbon mitigation. These benefits will multiply over time as new energy-efficient buildings penetrate the stock of older buildings in Denver.

The Greenprint Council also recommends that projects that exceed LEED Silver attainment be honored with a special Mayoral designation (to be determined at a later date).

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal

4% 

Initial Cost per Metric Ton of CO₂e Mitigated

\$18 – \$54/mtCO₂e 

Total Participant Cost or Investment

- Commercial buildings: Investment of 2 – 4 percent above present building cost, increased mortgage offset by monthly energy savings over time. Also, the incremental cost may be further reduced as the new standards become common practice.
- Residential homes: Investment of 2% per home with payback of ~10 years; increased mortgage costs offset by monthly energy savings over time. Also, the incremental cost may be further reduced as the new standards become common practice.

Expected 2012 Participation Rate

- Each year, 2.6 million square feet of Denver's commercial spaces and 1 percent of homes are new construction (based on 2005 data)

Expected 2020 Impact

- Up to 10 percent of Denver's building stock

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

INCREASE ENERGY EFFICIENCY IN EXISTING HOMES

Establish programs to ensure that older homes have basic energy- and water-efficiency features (for example, weatherization, roof insulation, pipe wrap, low-flow showerheads). Working with the local real estate community, consideration is being given as to how best to design and implement tools and activities that would result in increased energy efficiency while not unduly impeding the home sale process. Approaches may include simple checklists of energy efficiency items, free or very low cost materials, additional educational materials, and certain higher cost efficiency recommendations.

Add on in-home energy display systems for energy conservation and plant shade trees at strategic locations to further minimize summer heat in homes.

Special consideration and support should be provided for low-income residents. Programs currently exist to assist low-income residents in improving energy efficiency (for example, Colorado's Energy Savings Partnership (ESP) has provided more than \$3,000 in energy efficiency upgrades for low-income qualifying homes); efforts should be directed to further highlighting and improving access to these programs.

Efficiency programs, if widely adopted, could be one of the best ways to steadily reach and upgrade the vast stock of older homes in Denver (about 70 percent of Denver's homes were constructed prior to 1970). Water conservation, through changing fixtures to those with the best available technology, is an important side benefit.

Contribution to Denver's Greenhouse Gas Reduction Goal

1 – 4% 

Initial Cost per Metric Ton of CO₂e Mitigated

\$58/mtCO₂e 

Total Participant Cost or Investment

- Investment of up to \$1,000 per home with a payback of 4 – 6 years

Expected 2012 Participation Rate

- 25 percent of homes
- On average, about 5 percent of Denver's existing homes are resold each year

Expected 2020 Impact

- 8 percent



 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

COMMUNITY-WIDE HIGH-PERFORMING GREEN CONCRETE POLICY

Mandate a community-wide high-performing green concrete policy that requires the addition of fly ash to concrete in public and private projects. At a 20 percent mix with concrete, the use of fly ash (a by-product from coal-fired power plants) will save up to 25 percent of the carbon emissions associated with concrete, while making a highly durable, less expensive, and eco-efficient product. This policy will cover concrete used in public and private projects: roads, shopping malls, homes, etc. Refer to the latest Federal Highway Administration Materials Notebook guidelines for Portland Cement Concrete, which recommends a 15 to 25 percent range for fly ash. Engineering specifications and job-specific requirements will be taken into consideration when developing this policy.

The product's environmental safety has been demonstrated and the Colorado Department of Transportation already mandates 10 percent fly ash in concrete for infrastructure. Immediate savings of \$1/ton of concrete are expected from avoided cement use. However, many contractors are habituated to handling conventional concrete. This mandate is viewed as a way to lower the education barrier for a sustainable, equally durable product that offers significant cost savings through reduced use of virgin materials.

Denver would be the first city in the U.S. to implement such a program with:

- a) Quick and easy documentation of the amounts of fly ash used [such documentation is not presently available] and,
- b) An agreement with the fly ash suppliers to transfer the carbon credits to Denver. Through such documentation, Denver can lead other cities in green concrete implementation.

Note: Using fly ash to substitute for a portion of cement in concrete is currently economically beneficial, as fly ash typically costs less or the same as cement. Future supplies and costs of fly ash are likely to change as more cities institute fly ash concrete policies, with the potential to drive up demand. In addition, the utility of the fly ash may be impacted due to changes in power plant processes required to meet new mercury emission regulations. In the short term (up to 2012), fly ash supplies are projected to be adequate, making this a good policy for Denver; the longer term is more uncertain. To create a robust policy that addresses such uncertainty, we propose that Denver's mandate for fly ash inclusion in community-wide concrete use be in effect only as long as the cost of fly ash does not exceed the cost of cement.

Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal
3% 

Initial Cost per Metric Ton of CO₂e Mitigated
Immediate Savings

Total Participant Cost or Investment
• Up to \$1.2M/year saved

Expected 2012 Participation Rate
• 100 percent of new concrete



COMPACT GROWTH BOUNDARY WITH INCENTIVES FOR DENSITY IN URBAN AREAS

Limit Denver's growth boundary and adopt a package of policies and incentives to achieve focused density, particularly around mass transit hubs. This action seeks to support the growth of the Denver region's new population into transit-oriented mixed-use neighborhoods, increasing the local residential density, and favoring mass transit use and walkable/bikeable trips. Denver neighborhoods encourage walking/cycling and, when coupled with transit-oriented developments and car-share programs, can significantly reduce the number of vehicles owned and miles driven. Doubling residential density typically reduces miles driven by up to 25 percent.

A sustained program to increase urban density combined with support for maintenance of the existing Denver Regional Council of Governments (DRCOG) growth boundary will reap many benefits including more livable, walkable cities, healthier lifestyles, reduced transportation demand, and carbon mitigation. Densification, strategically coupled with mass transit, is one of the few documented ways for cities to reduce their travel demand over the long term. The densification levels considered here are very moderate and aim at countering suburban sprawl.

Contribution to Denver's Greenhouse Gas Reduction Goal

2%



Initial Cost per Metric Ton of CO₂e Mitigated

<\$1/mtCO₂e



Total Participant Cost or Investment

- Administrative costs to City

Expected 2020 Impact

- 10 percent



 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

CITY SUPPORT FOR ALTERNATIVE TRANSPORTATION STRATEGIES

Various City policies will be developed that facilitate reduction of motorized vehicle use in Denver and promote the use of alternatively fueled vehicles. These policies may include:

- Parking subsidies for car-share programs, and high fuel economy or alternatively fueled vehicles
- Access fee discounts for hybrid taxis at Denver International Airport
- Promote alternative transportation modes, such as bicycling, walking, telecommuting, van/car pools, and mass transit.
- Encourage businesses to provide showers for bike commuters and safe places for bike parking.

 Each globe symbol represents 100,000 metric tons of CO₂e mitigated per year or 5 percent towards Denver's 2012 goal.

 Each dollar sign represents a cost increment of \$15 per metric ton of CO₂e mitigated.

Contribution to Denver's 2012 Greenhouse Gas Reduction Goal
Up to 2% 

Initial Cost per Metric Ton of CO₂e Mitigated
Immediate Savings

Total Participant Cost or Investment

- Cost of hybrid taxis vs. conventional
- 70 car-share vehicles

Expected 2012 Participation Rate

- 100 conventional taxis replaced with hybrids
- 70 car-share vehicles used



Highlights of Denver's Top Ten Strategy Recommendations

Summary Tables 3-1 and 3-2 (provided on the next two pages) show the 2012 impacts, pathways, and engagement targets of all primary actions shown together to enable comparisons between all the recommendations.

Item	Greenhouse Gas Reductions Achieved via:				Expected 2012 Greenhouse Gas Reductions
	Built Environment Efficiency	Built Energy and Offset Purchases	Transportation System Efficiency	Materials Efficiency	
Corporate and Residential Climate Challenges	334,000	122,000	54,000	–	510,000 (28%)
– Corporate Climate Challenge	228,000	84,000	30,000	–	342,000 (19%)
– Residential Climate Challenge	106,000	38,000	24,000	–	168,000 (9%)
Incentivize Energy Conservation ¹	251,000	468,000	–	–	450,000 – 720,000 (25% – 40%)
Voluntary Travel Offset Program	–	360,000 ²	–	–	360,000 (20%)
City Leading By Example	24,000	95,000	36,000	18,000	173,000 (9%)
Enhance Recycling Programs	–	–	–	36,000	36,000 (2%)
Energy Efficiency Standards for New Buildings and Remodels	72,000	–	–	–	72,000 (4%)
Increase Energy Efficiency in Existing Homes	18,000 – 72,000	–	–	–	18,000 – 72,000 (1% – 4%)
Community-wide High-performing Green Concrete Policy	–	–	–	54,000	54,000 (3%)
Compact Growth Boundary with Incentives for Density in Urban Areas	–	–	36,000	–	36,000 (2%)
City Support for Alternative Transportation Strategies	–	–	27,000	–	27,000 (<2%)
TOTAL ANNUAL GREENHOUSE GAS MITIGATION BY 2012 (Denver's 2012 annual mitigation goal is 1.8 million mtCO ₂ e)					1.8 million – 2.3 million (>100% to goal)

Table 3-1

Expected greenhouse gas mitigation by pathway for Denver's primary strategies (mtCO₂e).

1. Greenhouse gas reduction from a tiered electricity rate come from the leverage of funds for renewable energy purchases and energy conservation projects.
2. Offsets for 360,000 mtCO₂e are typically applied to energy conservation or renewable purchases, not always occurring within the Denver community.

Table 3-2
Assumed 2012 Targets
for Action Items

Item	Targets for:				Expected 2012 Greenhouse Gas Reductions
	Built Environment Efficiency	Built Energy and Offset Purchases	Transportation System Efficiency	Materials Efficiency	
Corporate and Residential Climate Challenges	–	–	–	–	510,000 (28%)
– Corporate Climate Challenge	Businesses conserve 280 GWh of electricity	115 GWh purchased from Windsource ¹	25% worker participation in commuter benefits ²	Increased recycling rates (not quantified)	342,000 (19%)
– Residential Climate Challenge	Of Denver homes: 10% using smart meters, 54% in CFL program, 6% receiving free energy audits, 10% in energy blitz	95GWh purchased from Windsource ¹	15% reduction in car trips and miles traveled	–	168,000 (9%)
Incentivize Energy Conservation	–	Mandatory (100%) participation	–	–	450,000 – 720,000 (25% – 40%)
Voluntary Travel Offset Program	–	Reach 7% of drivers & 10% of air travelers	–	–	360,000 (20%)
City Leading By Example	DIA saves >10% energy (>30 GWh). Savings used to buy 120 GWh of Windsource	~120 GWh purchased from Windsource	Drives lowest mileage cars	100% use of green concrete	173,000 (9%)
Enhance Recycling Programs	–	–	–	5% recycling rate ²	36,000 (2%)
Energy Efficiency Standards for New Buildings and Remodels	Approximately 25% energy savings in new buildings and remodels	–	–	–	72,000 (4%)
Increase Energy Efficiency in Existing Homes	25% of homes upgraded by 2012	–	–	–	18,000 – 72,000 (1% – 4%)
Community-wide High-performing Green Concrete Policy	–	–	–	Community-wide Mandate	54,000 (3%)
Compact Growth Boundary with Incentives for Density in Urban Areas	–	–	25% Vehicle Miles Traveled Reduction ³	–	36,000 (2%)
City Support for Alternative Transportation Strategies	–	–	500 vehicles removed via car share, 100 taxis replaced with hybrids	–	27,000 (<2%)

1. Doubling of current amount
2. Doubling of current participation
3. Doubling of current density

SECTORS

The primary recommended Denver greenhouse gas mitigation strategies span the three major sectors seen in Denver’s Greenhouse Gas Inventory — Buildings/Facilities, Transportation, and Materials. This is illustrated in Figure 3-2 — with the most dominant mitigation occurring in the buildings and facilities sector.

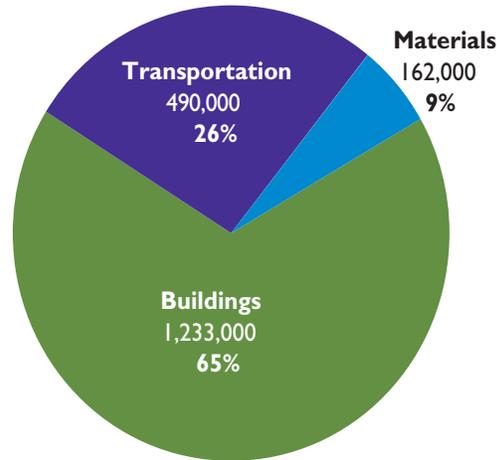


Figure 3-2

Denver Area’s Ten Primary Greenhouse Gas Mitigation Initiatives: Annual mtCO₂e mitigated and percent to 2012 goal are shown. A total of about 2 million metric tons of CO₂e are projected to be mitigated.

PATHWAYS

The Greenprint Council’s ten primary recommendations employ a diversity of pathways as illustrated in Figure 3-3. Note that efficiency/conservation pathways represent the most cost-effective means of mitigating greenhouse gas emissions while saving money to the Denver community over time.

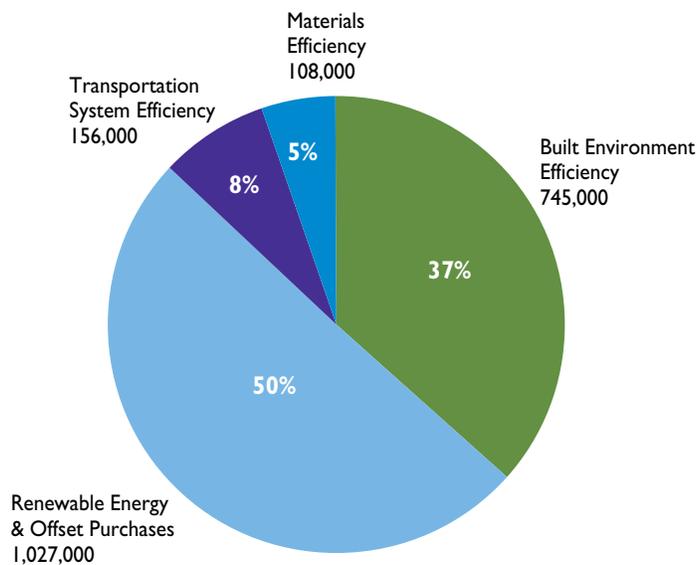


Figure 3-3

Greenhouse Gas Mitigation by Pathway for the Ten Primary Denver Strategies Recommended (mtCO₂e and percent to 2012 goal).

Implementation of the Primary Denver Strategies

The Greenprint Council envisions the implementation of Denver's Climate Action Plan as a multi-year process, involving a wide range of initiatives and City policy changes. Several of the recommendations would require some form of official City action, such as an ordinance or a change in City departmental policies. Others could be implemented fairly easily. The recommendations fall into a projected range of implementation target dates:

Short-term (can be implemented within 6 months to a year)

- Corporate and Residential Climate Challenges
- Voluntary Travel Offset Program
- Community-wide High-performing Green Concrete Policy

Medium-term (implementation projected between 1 to 3 years)

- Incentivize Energy Conservation
- City Leading by Example
- Enhance Recycling Programs
- Energy Efficiency Standards for New Buildings and Remodels
- City Support for Alternative Transportation Strategies

Long-term (will be implemented by the 2012 goal date)

- Increase Energy Efficiency in Existing Homes
- Compact Growth Boundary with Incentives for Density in Urban Areas



Section 4: Public Engagement Strategies

Overview

Engaging the public and producing behavior change is an important part of the public process regarding sustainability. Social marketing is a term used to describe non-traditional strategies that focus on changing behaviors. Widespread research confirms the effectiveness of social marketing tools to engage individuals and groups in improving their own lives and their communities.

Target Audiences

Three broad target groups within the community present themselves as candidates, based on their impact as public opinion leaders, a social network base, and grassroots impact. They are:

- **Businesses:** represent market drivers and public/civic leadership potential.
- **Neighborhoods:** represent the integrity, social fabric, and economic development opportunities within communities. This includes non-profit organizations operating within specific neighborhoods or throughout the community.
- **Youth:** represent the future. Young people of today typically care deeply for their environment and have a personal stake in fighting global warming.

Within these broad groups, specific target audiences may be identified for unique or specialized behavior change strategies. For example, within the business group, taxi cab drivers would constitute a subgroup to be targeted with incentives and opportunities to advance the use of hybrid-electric vehicles.

Short-Term Engagement Strategy Recommendations

1. Solicit a highly effective social marketing subject matter expert to create effective communications and social marketing strategies to advance the goals of the Mayor's Greenprint Denver initiative.
2. Identify and engage diverse stakeholders.
3. Identify funding sources and establish meaningful incentives that produce and support the desired outcomes.
4. Communicate to the public and target audiences about levels of success to sustain continued support and action.

A MODEL FOR YOUTH ENGAGEMENT AND NEIGHBORHOOD OUTREACH — THE HOME WATER CONSERVATION PROGRAM

A PARTNERSHIP BETWEEN MILE HIGH YOUTH CORPS (MHYC) AND DENVER WATER HAS GROWN OUT OF MHYC'S HOME ENERGY CONSERVATION PROJECT WITH THE GOVERNOR'S ENERGY OFFICE (GEO). MHYC IS WORKING WITH GEO TO INSTALL LOW-COST ENERGY SAVING MEASURES IN THE HOMES OF 2,000+ CLIENTS OF THE LOW-INCOME ENERGY ASSISTANCE PROGRAM (LEAP).

WHILE IN THE HOMES, CORPS MEMBERS ALSO ASSIST DENVER WATER BY INSTALLING LOW-FLOW AERATORS ON FAUCETS, INSTALLING LOW-FLOW SHOWERHEADS, ASSESSING WATER LEAKS AND DETERMINING IF TOILETS USE MORE THAN 3.5 GALLONS OF WATER PER FLUSH.

MHYC CREWS FROM THE HOME WATER CONSERVATION PROGRAM REPLACE HIGH WATER-USE TOILETS WITH FREE HIGH-EFFICIENCY TOILETS PROVIDED BY DENVER WATER. CLIENTS RECEIVE INFORMATION ABOUT HOW THEY CAN CONSERVE ENERGY AND WATER TO SAVE MONEY ON THEIR UTILITY BILLS.

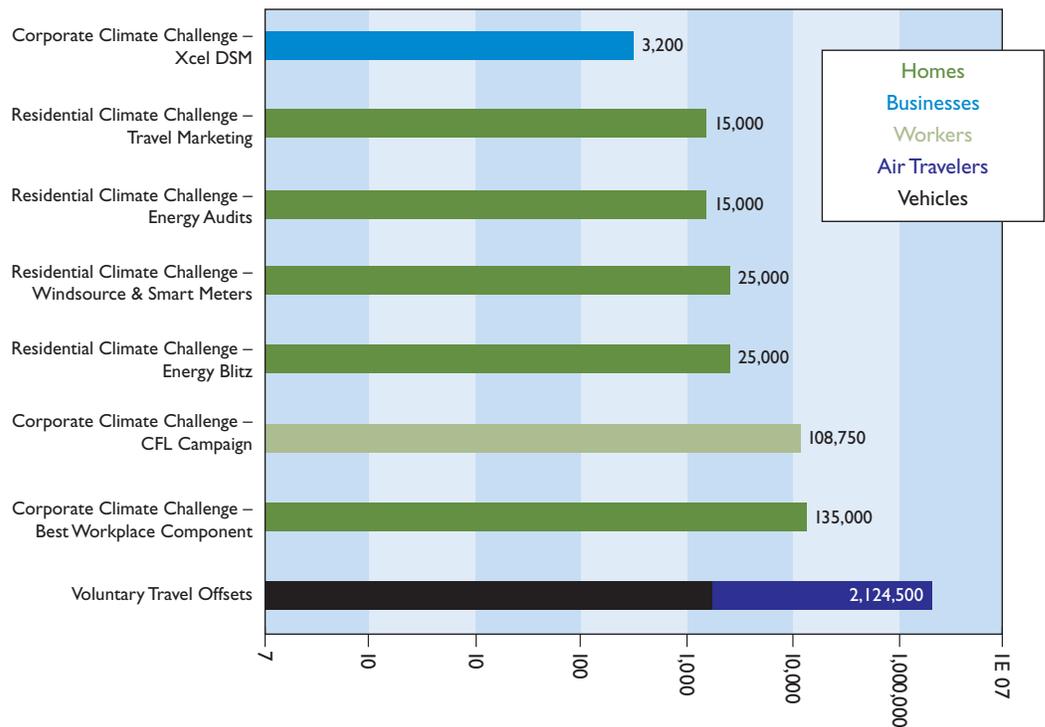
TO DATE, 1,519 HOMES HAVE RECEIVED ENERGY SAVINGS MEASURES AND THE INITIAL WATER CONSERVATION "AUDIT" AND 500 HOMES HAVE HAD HIGH-EFFICIENCY TOILETS INSTALLED, RESULTING IN A PROJECTED WATER SAVINGS OF OVER 14 MILLION GALLONS PER YEAR. PROGRAMS LIKE THIS ONE WOULD BE THE BASIS FOR THE NEIGHBORHOOD ENERGY "BLITZ" ENVISIONED IN THE RESIDENTIAL ENERGY CHALLENGE.

Long-Term Recommendations (Beyond 2012)

1. The Greenprint Denver Council should work with strategic communications and social marketing experts and Greenprint Denver staff to guide and advance implementation strategies for continued behavior change actions, recommend possible funding streams, partnership opportunities, and other program capacity development over a long-term horizon (2030 or 2050) to allow sufficient time to mainstream building upgrades, retrofits, green market development, and other long-term infrastructure improvements.
2. A long-term commitment, with sustained encouragement and messaging, is required to support the desired behavior change(s). The focus must be both on the near term, but also futuristic, looking 20+ years ahead.
3. Broad partnerships with educators as well as business, cultural, and community leaders are needed to leverage resources and build civic and leadership capacity to effect change.

The Greenprint Council's ten Primary Denver Strategies will require significant public engagement, illustrated in the following bar graph. Targeted engagement and participation rates are largely based on doubling Denver's current participation in conservation programs, along with one or two special outreach programs (for example, Compact Fluorescent Lamps distribution and Individualized Travel Marketing) shown to be successful in other cities, that are expected to reach at least 50 percent of the target populations in Denver.

Figure 4-1
Engagement numbers for outreach initiatives



No matter which priorities are established by the Mayor, engaging the public to produce behavioral changes will be an important and necessary step to guarantee success. The level of public engagement and the target audiences for each desired behavioral change will likely vary. The strategies and recommendations discussed above should not be considered the entire engagement program; they will continue to evolve and expand. It is premature to develop complete public engagement strategy recommendations until we know which of the Greenprint Denver Council's recommendations will be advanced. Once a list of priorities is established, we anticipate the development of a full plan to engage appropriate target audiences via a social marketing campaign to achieve the desired results.

Section 5: Conclusion

The need for Denver to adopt a plan of action to reduce greenhouse gas emissions is clear and urgent. We now understand Denver's challenges and what steps lead to a more sustainable future. By implementing the recommendations outlined in this report, Denver can achieve a 10 percent reduction in per capita greenhouse gas emissions from 1990 levels by 2012. However, with its growing population, Denver's absolute emissions will continue to rise along with the mounting risks of climate change. Thus, this Greenprint Council recommends that more aggressive approaches be adopted to achieve a 25 percent absolute reduction in emissions by 2020. The need is imperative and the opportunities are abundant.

A century ago, visionary leadership created a legacy, the roots of which have made Denver the great city it is today. It will once again take visionary leadership coupled with courageous action and an engaged citizenry to ensure that this great city survives and prospers. The threat of global warming cannot be finessed. It may be tomorrow's threat, but the time for action is today. Together, our community can make a decisive difference.

We have envisioned a pathway to a future that is not only necessary, but also practical, possible, and beneficial. As other cities both nationally and internationally have demonstrated, we **can** reduce greenhouse gas emissions across the Transportation, Residential, and Commercial/Industrial sectors through a dynamic combination of incentives, mandates, and voluntary outreach. We **can** reduce energy consumption without sacrificing our standard of living. We **can** promote new and clean businesses that provide high-quality jobs. We **can** improve our health, well-being, and quality of life. We **can** eliminate the need for additional coal-fired power plants. We **know** what to do and now we **must** engage the public in getting it done. Our future depends on it.



Acronyms and Abbreviations

AFV	alternative-fueled vehicle
CFL	compact fluorescent lamp
CH ₄	methane
CO ₂	carbon dioxide
DDP	Downtown Denver Partnership
DIA	Denver International Airport
DRCOG	Denver Regional Council of Governments
DSM	Demand Side Management
GPC	Greenprint Council
GPD	Greenprint Denver
GWh	Gigawatt hour
ICLEI	International Council for Local Environmental Initiatives
kBtu/sq ft	thousand British thermal units per square foot
kWh	kilowatt hour
mtCO ₂ e	metric tons of carbon dioxide equivalent
NO _x	nitrogen oxides
SUV	sport utility vehicle
therm	unit of heat energy equal to 100,000 British thermal units
VMT	vehicle miles traveled

Secondary Strategies

The Greenprint Council also recommends the adoption of the following initiatives, which have a smaller individual impact on Denver's greenhouse gas reduction goals but are worth pursuing for their potential long-term impact on markets and individual behavior.

- **City Facilitation of Market Mechanisms in the Buildings Sector** — Various City policies to facilitate the purchase of energy-efficient appliances and the purchase of solar/renewable technologies resulting in lowered energy demand. Policies could include:
 - Replacement of very old refrigerators in low-income neighborhoods — Replacement of pre-1993 refrigerators with current Energy Star models saves approximately 1,000 kWh per household annually (this policy has been successfully initiated in Wisconsin, Iowa, and Indiana).
 - Community-wide replacement of older refrigerators — Replacement of pre-2001 refrigerators with current Energy Star models saves approximately 400 kWh per household annually.
 - Rebates for New Energy Star Appliance Purchases
 - Rebates for Solar/Renewable Technologies (photovoltaics, solar hot water heaters, geothermal heat pumps, etc.)

Percent to goal: 2 percent (refrigerator program alone is greater than 1 percent)

- **Recycling of Demolition Debris** — City policy would require that at least 50 percent of demolition debris that can be recycled be removed by a contractor prior to final land-clearing activities at a demolition site.

Percent to goal: ~1 percent



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